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Some Recent Advances in the Physiology of Cardiac Function*

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[Professor Bogue said that he proposed to consider some aspects of the electrical, mechanical and chemical phenomena exhibited by the heart under varying conditions. The speaker demonstrated his points by means of electrical and mechanical recordings and diagrammatic slides; space and economy does not permit of reproduction of the records, but the following with a few of the key figures is a summary of the subject matter from which the lecture was given.]

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In the present article it is proposed to give a description of the experimental work which has recently been carried out on the heart. In a future article, the possible clinical significance will be dealt with on the basis of these findings.

It is well known that active muscle shows electrical changes during excitation, and that if suitable leads be taken from two points on the surface of the heart to an Einthoven galvanometer, then potential changes which are due to the activity of the tissue can be recorded photographically. Such a record is known as an electrocardiogram and can be taken from the intact subject by leading off from the limbs. The electrocardiogram is of great value in human clinical medicine, but is too costly for general use in veterinary practice, but as much work has been done on animals and some of the veterinary colleges now possess electrocardiographic equipment, it might be of interest to discuss some of the phenomena not usually found in clinical books dealing with the interpretation of the electro-cardiogram.

The significance of the Fibrillary and/or Syncitial Heart Structure.—Since the form of the electrocardiogram can be modified by disease and alterations in the myocardium, it is of interest both from a practical and a theoretical point of view to find out the relationship between the form of the electrical response and the development of cardiac structure. It has been stated that the form of the electrical response is dependent upon the presence of fibrillary and/or syncytial structure. If this is the case then electrical records of the embryonic heart from the earliest stages should show changes corresponding with the appearance of more highly organised structures. This can be most easily done in the chick's heart. The first regular contractions of the heart are evident about the 15 to 17 somite stage (about 40 hours of incubation), at this stage the heart is a simple tube and there is no fibrillary structure. According to Weiman the development of fibrils and of syncytial-like structures does not appear until the fifth day of incubation. Warren H. Lewis does not accept the view that embryonic heart muscle is syncytial, a syncytium being defined as a complete continuity of cell substance, or according to Jordan and Ferguson "tissues in which cell boundaries are absent are known as syncytia . . . ."

Lewis put forward three reasons for his view that the heart muscle cells of the embryo are adherent and not formed into a syncytium.

(1) Distinct cell boundaries are sometimes visible after treatment with $AgNO_3$.

(2) Single cells in cultures may migrate and become completely separate from the reticulum.

(3) Individual cells often beat at a rhythm of their own, while adjoining cells may beat at different rates, it is unlikely that cells which are fused would beat at different rates.

With regard to the myofibrillae, Lewis believes that these are not true physiological structures but are dependent upon the way in which the cytoplasm coagulates on fixation.

The electrocardiagram of the developing chick was investigated by Bogue (1933); the results of this work are summarised in Fig. 1, in which the development of the heart and the electrocardiogram are shown from the 10 somite to the 40 somite stage (32 to 96 hours of incubation). At 32 hours there are no regular beats, at 40 hours, however, the heart beats regularly at 120 to 170 beats per minute.

*Address to the Central Veterinary Society, at the Conway Hall, W.C.1, on May 4th, 1939.

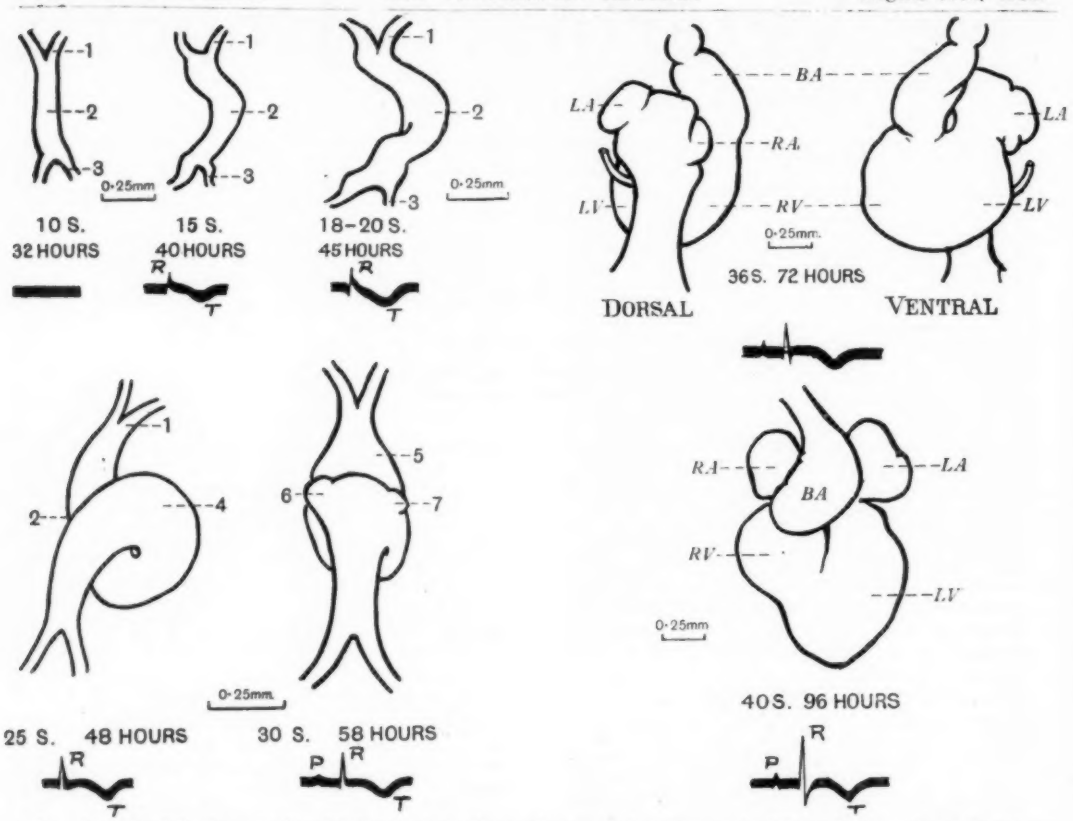

Fig. 1.—Electrical records obtained at various stages of development of the chick embryo heart. 10 *S*, etc., denotes the number of somites. Hours denote period of incubation. 1, ventral aorta. 2, primitive cardiac tube. 3, vitelline vein. 4, developing atrium. 5, developing ventricle. 6 and 7, left and right auricular buds. *LA* and *RA*, left and right auricles. *LV* and *RV*, left and right ventricles. *BA*, bulbous arteriosus. Diagram at 72 hours partly after Lillie.

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Below the drawing is seen the corresponding electrocardiogram; the fast and slow components of the complex, the R and T waves are clearly visible, these complexes corresponding with ventricular activity in the adult. Between 48 and 60 hours there is a particularly obvious morphological change, the appearance of the auricular buds. They are contractile and the electrocardiogram shows a corresponding change, an additional wave is now apparent preceding the R wave. This is the P wave and corresponds with auricular activity in the adult. At this stage the electrocardiogram is therefore essentially the same as that of the adult. At 96 hours, when the heart chambers are clearly differentiated, the electrocardiogram is the same. It is obvious, therefore, that the form of the electrocardiogram cannot be dependent upon the presence of fibrillae or upon syncytial formation for the two following reasons: Firstly, if we accept Lewis' findings that there is no syncytial structure and that fibrillae are artifacts, then naturally there is no argument. Secondly, if we do not accept Lewis' conclusions and admit the existence of syncytial and fibrilliary structure, there can still be no relationship since these structures are not evident until 130 hours of incubation and it has been shown that there is a fast and slow component in the electrical response at less than 40 hours, and an essentially complete electrocardiogram is obtained at between 40 and 60 hours. The time relations of the electrical records show a remarkable resemblance to those found in the adult although the adult heart weighs 15 gm. and the early embryonic heart not more than 1 mg.

The relation between the Mechanical and Electrical Response of the Heart.—Some years ago Mines (1913) observed when the extent of the beat of the isolated heart was reduced to less than 1 per cent. of the original that the height of the electrical response was unaltered.

Other workers, Einthoven and Hugenholtz, claimed that the height of the mechanical and electrical responses of the isolated frog's heart varied *pari passu* when the heart was perfused with fluids containing excess of potassium or lack of calcium. This question was reinvestigated by Bogue and Mendez (1930) since it is of importance to know whether the height of the electrical response (voltage) is proportional to the strength of the mechanical response. Various procedures such as lack of calcium, excess of potassium, alteration of *p*H, increasing and decreasing the filling of the heart, all of which alter the force of contraction, were investigated on the frog's heart.

It was found that the heights of the mechanical and electrical responses could vary independently and that there was no relationship between the heights of the initial electrical deflection and the force of contraction. This can be clearly seen in Fig. 2 which shows the recovery of the mechanical response after it had been reduced with calcium-free Ringer; the height of the mechanical response increases about ten fold while the height of the electrical response remains unaltered. Excess of potassium reduces the mechanical response and renders the electrical response abnormal but not smaller. Acetyl choline reduces the mechanical response but does not reduce the electrical response. Emptying the heart causes a decrease in the mechanical response and an increase in the height of the electrical response. Alcohol and acid decrease the mechanical response and also render the electrical response abnormal and smaller. It is, therefore, possible to reduce the height of the mechanical response without affecting the electrical response; on the other hand it has not been possible with such procedures to reduce the electrical response without at the same time reducing the extent of the beat.

The Blood-fed Isolated Mammalian Heart.—Mammalian heart muscle only will be considered, and since it is probably of more general interest, the discussion will be confined to carbohydrate metabolism and to certain mechanical phenomena. The general factors controlling the output of the heart and its nervous control are dealt with in many easily accessible text-books of physiology.

Until quite recently work on the metabolism of the heart was complicated by a number of factors which were difficult to control or avoid. Work on the intact animal is not very satisfactory since changes which take place in the constituents of the blood are small and subject to large experimental error over short periods of time; there are in addition many other obvious technical difficulties.

The obvious preparation to use was the heart-lung preparation, and much work has been done upon it. It was quite easy to measure the rate of disappearance of sugar from the blood for example and to express it in terms of time, heart weight and work after making allowance for glycolysis of the sugar in the blood. By this method it was found that the heart used between 200 and 500 mg./100gm/hr., but it was not realised until 1933 that the true usage of glucose was of the order of 70 to 100 mg./100gm/hr.; this latter figure was found by analysing coronary blood, the difference was found to be due to the presence of the lungs. Evans, Hsu and Kosaka (1934) perfused isolated lungs and were able to show a sugar usage and a lactic acid production. In normal blood, sugar is converted to lactic acid by glycolysis, but in the case of blood perfused through the lungs this process

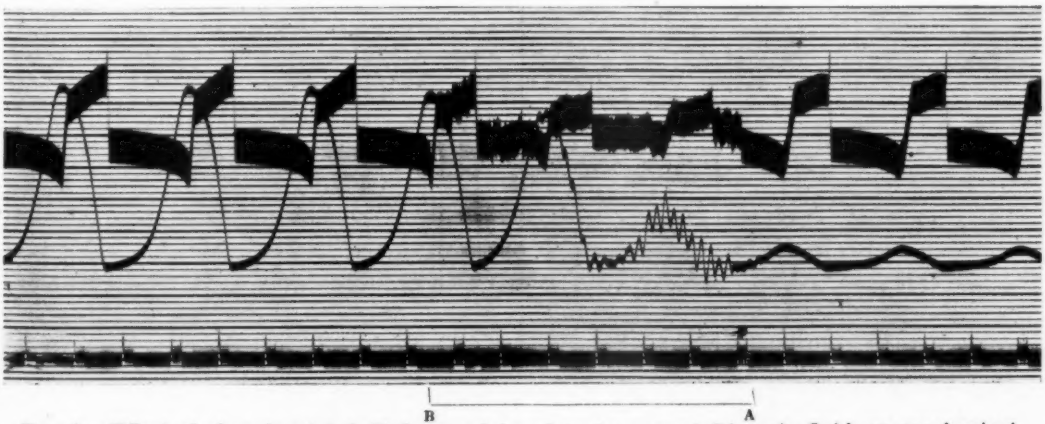

Fig. 2.—Effect of changing (at *A–B*) from calcium-free to normal Ringer's fluid on mechanical and monophasic electrical responses of strip of frog's ventricle. Read from right to left.
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is accelerated; with a blood sugar of 100 mg. per cent., 50 mg. of lactic acid per 100 gm. of lung per hour were produced. Work on the heart-lung perparation is therefore open to criticism.

In 1934 Evans, Grande and Hsu succeeded in replacing the lungs by an artificial oxygenator and by this means were able to study the metabolism of the blood-fed heart alone. A modification of the circuit was made by Bogue and Gregory (Fig. 3).

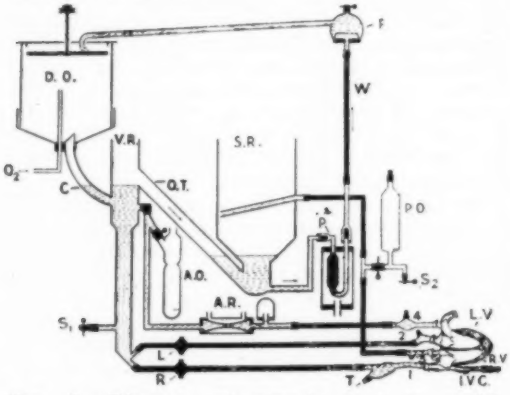

FIG. 3.—Diagram of circuit (not to scale). [*Reproduced, by permission, from the "Quarterly Journal of Experimental Physiology and Cognate Medical Sciences." Vol. 29. No. 1. 1939.*]

The two sides of the heart are supplied with defibrinated blood from the constant-level reservoir VR, via two cannulae inserted into the superior vena cava and the left auricular appendix. The rate of inflow to the two sides can be varied independently by regulators R and L. Blood is pumped around the apparatus by means of a pump P, which draws blood from the stock reservoir, SR, the output of the pump being carried through a filter F and then led to the spinning plate of the oxygenator DO, the blood is thrown on to the walls of a cylinder which contains suitable gas mixtures. Blood from the oxygenator flows into the supply reservoir VR, and since the output of the pump is adjusted so that the flow is greater than the requirements of the heart then the excess blood will flow down the tube OT into the reservoir SR. The head of pressure in VR will therefore be constant.

Blood from the aorta passes via cannula 4 through a pneumatic resistance AR, which can be adjusted so as to vary the resistance against which the left heart must work. From here the blood is led back to the reservoir VR. The aortic flow (which is the left ventricular output minus the coronary flow) can be measured in the graduated vessel AO. The output of the right ventricle consists of that entering from cannula 1, and the venous return from the coronary veins, which of course will have lost some of its oxygen, is conveyed by cannula 3 to the stock reservoir SR. This partly deoxygenated blood is then conveyed by the pump to the oxygenator as already described; the total output of the right ventricle is measured by means of the graduated vessel PO. The coronary flow is measured by clamping off the inflow R, then measuring the output at PO since the only blood entering the right ventricle is that from the coronary veins. Samples of coronary blood can be drawn at S_2, and compared with arterial samples taken at S_1, or AO. The two ventricular pressures are recorded from the side arms of cannulae 3 and 4 by means of mercury manometers; the auricular pressure by means of water manometers connected with the inferior vena cava on the right side and with the side arm of cannula 2 on the left side, the four pressures being recorded simultaneously on a kymograph.

Analysis of the reservoir blood taken at S_1 is made at intervals and the rate of disappearance of various substances observed, after making due allowance for glycolysis with control blood under similar conditions but not passed through the heart.

The carbohydrate metabolism of the isolated dog heart has been studied by Evans, Grande and Hsu, 1934, 1935; Evans, Grande, Hsu, Lee and Mulder, 1935; Bogue, Evans, Grande and Hsu, 1935; Bogue, Chang and Gregory, 1938; and Bogue, Evans and Gregory, 1939, all using the heart oxygenator preparation. The following is a brief summary of their results. Those interested in a more detailed summary should consult Evans' Recent Advances in Physiology, by Newton, 6th Edition, 1939, Churchill Ltd., London, in which there is a chapter by Professor Lovatt Evans on the metabolism of cardiac muscle.

Administration of adrenaline causes increased metabolism, coronary flow and oxygen usage, even if the work remains unaltered. Provided there is sufficient glucose present in the blood, the utilisation of glucose is increased, there is also, as will be seen later, a mobilisation of the heart glycogen. The normal glucose usage of the heart depends upon the initial level of glucose in the blood, the amount of lactic acid present and the work done by the heart. It is comparatively easy to vary the amount of work, this is accomplished by varying the aortic resistance A.O. or the inflows via L and R, or both.

Increasing the aortic resistance only will, however, result in a larger coronary flow than one would get by increasing the outputs of the ventricles to give a similar amount of work. It is therefore better to increase or decrease the outputs and the aortic resistance together.

A ten-fold increase in the work will increase the sugar usage by about 60 per cent., for example, in one experiment the increase was from 54 to 89 mg./100 gm./hr. This lack of proportion is partly due to the increased efficiency with which the higher grade of work is done.

The most important observation is, however, that the heart is capable of utilising lactic acid, in fact more lactic acid is taken up than any other substance. When the heart is using glucose at 70 to 80 mg./hr, we have a usage of lactic acid of the order of 200 mg./100 gm./hr.

taking place at the same time, provided that the concentration of lactic acid in the blood is sufficiently high. The rate of utilisation of lactic acid depends upon the concentration of lactate in the blood, the concentration of glucose, the rate of work and the oxygen supply. It appears that the usage of lactic acid or glucose tends to vary directly as its own concentration and inversely as that of the other constituent in the blood. Increase in the concentration of either glucose or lactic acid caused an increased usage of that substance for the same amount of work and a decreased usage of the other. Addition of glucose while it increases the glucose usage does not lower the usage of lactic acid to anything like the same degree as the addition of lactate lowers the usage of sugar, this means that the heart prefers lactate to glucose. If this utilisation of lactic acid (which can be experimentally added to the blood as sodium lactate) is a normal phenomenon, then procedures which increase the oxygen usage such as adrenaline or higher work should increase the usage of lactate. Increasing the work of the heart ten fold caused an increase of about 60 per cent. in the sugar usage but at the same time the lactate usage was increased by over 90 per cent. It is of interest to note that even the increase in the sum usage of the two is not directly proportional to the increase in work.

If the lactate level is kept up by constant additions, then adrenaline will increase the rate of usage of lactate, and the rate of lactate usage is increased more than that of glucose. If the lactate level is allowed to fall to a low level then the heart turns over to glucose. If on the other hand the glucose level is allowed to fall so low that there is no glucose usage, then the heart can carry on perfectly satisfactorily using lactate only.

Continued administration of adrenaline in spite of the presence of adequate quantities of glucose and lactate results in a depletion of the heart's store of glycogen, 1cc. of 1:1000 adrenaline given over a period of 2 hours will reduce the heart glycogen below 0·1 per cent. if the sugar and lactate levels are allowed to fall, or to about 0·3 per cent. if sugar and lactate be available (normal about 0·7 per cent.). Under ordinary conditions without adrenaline if the blood sugar and lactate concentrations are allowed to fall, then the heart mobilises its own glycogen for its energy requirements, so that the glycogen content of the heart at the end of such an experiment will be low. Prolonged low sugar in the blood but with adequate lactate, does not embarrass the heart nor does the heart call on its glycogen, high sugar and low lactate has a similar effect. Addition of glucose, after the heart had been allowed to deplete its glycogen reserves, resulted in a rapid deplenishment. If lactate were added instead, the heart improved its condition, but there was no replacement of glycogen. It appears that lactate is used by the heart to meet its immediate energy requirements and that sugar is used to replace glycogen. This has been shown by Bogue, Evans and Gregory as follows. A heart is driven by a continuous infusion of adrenaline while doing a high grade of work, the blood glucose and lactate are allowed to fall, the glycogen will become exhausted after about two hours and the heart will suddenly fail when the glycogen level is about 0·05 per cent. The approach of these conditions is reflected in the venous pressure which shows an abrupt rise just before failure takes place. If, just before the rapid rate of rise of the venous pressure, the mechanical work is reduced and the adrenaline withdrawn, the effect of subsequent additions of lactate or glucose can be studied with the knowledge that the glycogen was low, about 0·1 per cent. when the addition began. Addition of lactate enables the heart to continue in good condition for two or more hours, but it is found that there has been no replacement of glycogen, the level remaining at about 0·1 per cent. If glucose is added instead there is a considerable restoration of glycogen, though the level attained is still below the normal after two hours. Heart glycogen is therefore formed from glucose. Addition of both glucose and lactate together to a heart depleted of glycogen by adrenaline, results in a smaller replacement of glycogen than with glucose alone. This may be due to the fact already mentioned that high lactate depresses the glucose usage of the heart. High glucose or lactate in the blood will not prevent the depletion of glycogen in the adrenaline driven heart.. It appears, therefore, that provided the energy expenditure is not too high the requirements can be met by glucose and lactate and any utilisation of glycogen which may occur is immediately made up. If, however, the energy expenditure be augmented beyond a certain degree then the glycogen is called on so that the quantity falls, and the lower level can be most readily restored by the addition of glucose.

The above suggests that in the failing heart it is probably better to administer sodium lactate since this fuel is more readily utilised and further the dilatation of the coronary arteries which accompanies lactate administration is beneficial. In a heart failing from progressively falling oxygen tensions in the blood, lactate does not prolong the survival time, but it may be prolonged by glucose.

Some Mechanical Phenomena Exhibited by the Isolated Heart.—Work on the heart-lung preparation by Starling and others has given us a clear idea of the mechanical factors determining the output of the heart, and has also shown that the energy of contraction is a function of

the length of the muscle fibres, this is known as "The Law of the Heart." These results still hold good, of course, in respect of the isolated heart without lungs.

In the heart-lung preparation, variations in the inflow or in the output of the right ventricle must naturally be reflected in the inflow to the left heart, since the supply of blood to the left heart, as in life, is from the lungs and therefore from the right heart. In the heart oxygenator preparation, however, the inflows to the right and left heart are independent so that it is possible to vary the mechanical conditions on the one side without varying those on the other. Here we will only consider one aspect, that is the effects of varying the pulmonary resistance, *i.e.*, the resistance against which the right ventricle must work, keeping the left inflow and aortic resistance constant.

In order to familiarise the reader with the working of the preparation, Fig. 4 is given to

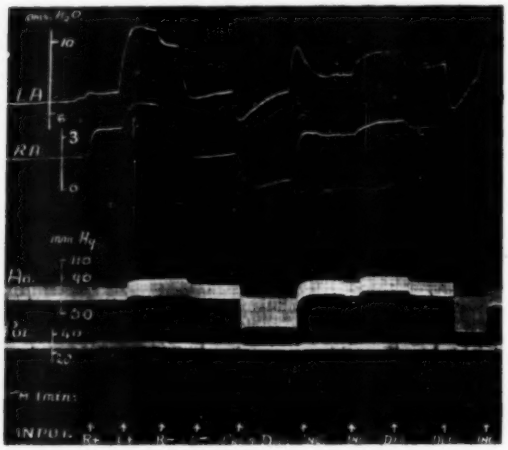

Fig. 4.

show the effects of (*a*) increasing the right inflow; note the rise in the right auricular pressure, RA, and little effect on the left auricular pressure, LA; note effect on the aortic pressure, AO, and very slight rise in the pulmonary pressure, Pul. (*b*) increase in the left inflow not only causes an increase in the left auricular pressure but also in the right auricular pressure as well: this does not occur if the pericardium is opened; there is, of course, a slight increase in aortic pressure. As can be seen these changes are reversible. The effects of decreasing and of increasing the aortic resistance (AO in the circuit diagram) are also shown.

Fig. 5 is of interest since it shows the effects of increasing the right and left inflows simultaneously; both auricular pressures rise. The aortic resistance was then increased, but the heart was at first unable to deal with these

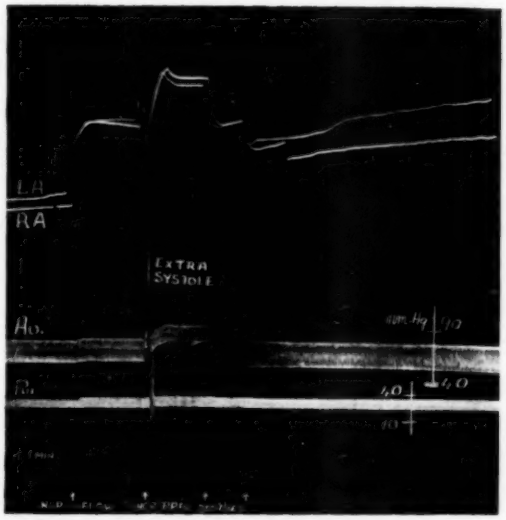

Fig. 5.

conditions: note the extra systole due to the accumulation of blood in the heart and the increased tension set up in the ventricles.

If the resistance against which the right heart has to pump is increased, without altering the conditions on the left side of the heart, the output of the left ventricle will decrease as measured by the aortic flow, in spite of the fact that the supply of blood to the left ventricle is still the same. Both auricular pressures rise indicating that the heart is unable to expel the blood as efficiently as before; the heart dilates. The reason for this is apparent when the coronary flow is examined; this is found to decrease, decrease in the coronary flow results in decreased efficiency of the ventricles. For example an increase in the pulmonary resistance from about 5 m.m. of mercury to 50 m.m. mercury will reduce the aortic flow from 170 to 90 c.c. per minute, the coronary flow will also be halved. The reason for this is as follows—increase in the pulmonary resistance results in an increased pressure inside the right ventricle, this increased pressure tends to oppose the drainage of the coronary blood into the right heart, there is as it were a back pressure, this back pressure therefore does not allow a free inflow of coronary venous blood into the right heart so that the coronary flow is decreased and therefore the ability of the left heart to get rid of its blood is also decreased.

The rise in venous pressure can be reduced by lowering the aortic resistance; this, of course, means that the heart is now performing less work but is able to do it more efficiently, provided there is sufficient aortic resistance to maintain an optimal coronary flow for the conditions pertaining at the time.

The rise in venous pressure is not so marked when the pericardium is opened, since the heart can now expand more and so according to the Law of the Heart expel its contents more efficiently within certain limits.

The discussion was opened by Dr. H. Rosenberg, of the Royal Veterinary College, who, in the course of his remarks, first congratulated Dr. Bogue on his lucid presentation of this difficult subject and upon the information he had given on so many important details contributed by his own research.

He imagined that many members of that Society had considered the question as to how far these results might apply to natural conditions. He would like to explain, therefore, the necessity for the physiologist of adopting the artificial procedure of working with isolated organs.

If we set about investigating the action of the heart in the intact animal, it meant having all the difficulties which arose from the complex, nervous and hormonal, adjustments of the general circulation to variations of arterial pressure, venous return and so forth. This was the great advance made by Starling with his heart-lung preparation, that we could avoid uncontrollable influences and regulate the resistance to the arterial outflow, *i.e.*, the pressure, and the venous inflow independently while the heart rate could be kept constant or, within limits, changed at will. The next step was to cut out variables for which the lung was responsible, and this had been achieved by Bogue and his collaborators: to remove the interference of chemical changes taking place in the lung.

The present knowledge of work and metabolism of the heart under simplified conditions enabled us to find out how the responses were modified by the nerves supplying the heart. Starling had tried to ascertain the effects of vagal and sympathetic stimulation of the heart on its oxygen usage. Starling thought that any differences in oxygen consumption could be explained by the variations in frequency. They might, however, remember that, in addition to the inhibition, tonic and electrical effects of vagus stimulation on the heart had been claimed, and recent experiments on heart preparations with the complete nervous supply intact indicated that the two sets of autonomic nerves actually had a specific, either inhibiting or stimulating, influence on the metabolism of the heart muscle. In this way, introducing partial factors step by step, the physiologists evolved the concept of the working whole.

He thought that Dr. Bogue had made observations on sympathectomised dogs, having a bearing on this problem. In such animals the importance of the heart nerves for the adaptation, *e.g.*, to work such as running, could be studied under fairly normal conditions. He felt it would be of general interest if Dr. Bogue might comment on the results obtained by such experiments.

Professor G. H. Wooldridge said that he had been trying, throughout Dr. Bogue's very instructive description—which he had not been able to follow altogether—to link it up with matters of a clinical nature. In that connection, he was rather impressed with his explanation of how the heart varied when there was a severe venous pressure on the right auricle, and that brought to his mind the fact that in nearly all cases of pneumonia that ended fatally it was the heart that petered out. Dr. Bogue had explained to them how that occurred, but it did appear to most of them, he thought, that the reason the heart failed then was because it was just simply mechanically incapable of driving the blood through the lungs in that state of congestion. They now knew that that was the case, but only as the primary cause, and that the actual cause was the interference with the flow of coronary blood into the right heart. He wondered if that finding did not bring them back to the old method of treatment in cases of congestion of the lungs, namely, venesection, whereby the right side of the heart would be very considerably relieved and the return of the coronary blood permitted, so reducing the damage to the left heart. If his interpretation was correct, they might to some extent return to that old method of affording relief.

One other thing he would like to know was in respect of the use of glucose or of lactic acid. As Dr. Bogue was well aware, they frequently injected glucose into the blood stream in cases of defective heart, and he was wondering if they would not get an even greater degree of benefit if certain lactic acid preparations were used in preference to glucose; if so, perhaps Dr. Bogue could help them definitely on that side.

Mr. C. W. Ottaway observed that there were many points they might like to discuss in a paper of this nature, but he would confine his remarks to one aspect only. Professor Bogue had mentioned several features as regards the effect of drugs on the heart, and Dr. Rosenberg had referred to the nerves which are associated with the actions of these drugs; he was wondering if Professor Bogue could tell them of any experiments on a totally sympathectomised dog that would throw light on the relation between the action of these drugs, and the nerves which convey their impulse.

Mr. A. N. Worden referred to another important factor in cardiac physiology, namely, vitamin B_1. He reminded them that this vitamin was required by at least four domestic species—the dog, cat, pig and fowl. Cardiac disease, with the risk of sudden heart failure, had long been known to occur in beri-beri, especially in its severest forms. A typical "beri-beri heart" was said to be hypertrophied and to show marked dilatation of the right ventricle. Although these cardiac abnormalities had formerly been ascribed to inflammation of the vagi, it was now known that the injection of B_1 concentrates led to spectacular recoveries, the size of the heart and the electrocardiogram both returning to normal. In 1928, McCarrison and his two co-workers had produced a condition of hypovitaminosis B_1 in pigeons, and had stated that it differed quite markedly from the very acute polyneuritis which could be brought about in pigeons and fowls on a completely B_1-free diet—an observation which was, perhaps, of

considerable value to those confronted with suspected vitamin deficiencies in the field. A characteristic feature of this hypovitaminosis had been cardiac enlargement and dilatation. In rats which were suffering from a B_1 deficiency, a sinus bradycardia developed and appeared to be a specific symptom in that it was promptly relieved by B_1 therapy. Further, although the amounts of B_1 stored in the body were not large, the highest concentrations were present in heart and liver tissue.

There was thus abundant evidence that vitamin B_1 was essential for normal cardiac function in at any rate some species, although its exact rôle was not established. Professor Bogue had referred to the "remarkable fact" that the failing heart found lactate to be beneficial: in vitamin B_1 deficiency, there was a tendency for pyruvic and lactic acids to accumulate in the blood and tissues, and in a recent paper in the *Skandinavisches Archiv für Physiologie* (1938. 79. 303-312), Kalaja and Närvänen had shown that the injection into rats of either lactic or pyruvic acid—as well as of certain other metabolites believed to accumulate in B deficiency—led to a marked retarding effect upon the heart's action. These acids had been previously neutralised with sodium hydroxide, although the dosages employed seemed to have been rather high.

In a short annotation in the *Veterinary Record* rather more than a year ago, Professor Bogue had referred to certain simple methods for determining blood pressure in animals. He would be greatly obliged if Professor Bogue could give them further details of these methods. He himself had often attempted to take a horse's blood pressure by means of an ordinary sphygmomanometer, but had found it almost impossible to obtain any readings at all. As the animals in question had all been at the Royal Veterinary College, however, this was perhaps not a fair trial! (Laughter.) The fact remained that they had not in veterinary practice any simple and reliable method for registering arterial blood pressure, and he felt sure that they would all be grateful if Professor Bogue could indicate such a method.

Mr. J. Francis said that lactic acid could be utilised by heart muscle but not by voluntary muscle, and in high concentrations was even toxic. He went on to ask if it were true that the physiology of heart muscle was entirely different from that of voluntary muscle. He would be interested to know Dr., Bogue's opinion as to whether or not the lesions of azoturia in horses could be produced by the sudden accumulation of lactic acid in the muscles of the quarter, when the horse was first put to work after a somewhat protracted period fo rest.

Dr. Rosenberg stated that during the War he used to make venesection in cases of pneumonia and in some instances observed a dramatic recovery in people who looked to be dying. The final result, of course, was dependent upon the changes in the lungs which might still lead to death; but cardiac failure might be overcome at some dangerous stage by venesection while other measures were ineffective.

Professor Wooldridge stated that, in that connection, he might say that in the case of hunters, in the field in the early part of the season, affected with acute congestion of the lungs, a rapid venesection produced the same spectacular results as those Professor Bogue had achieved in the human subject. He thought it was by far the best method of early treatment.

The Reply

Time did not allow of an extended reply to the discussion, but dealing with certain points raised Professor Bogue said, in regard to venesection, it might be desirable where a high pulmonary pressure caused a decrease in the coronary flow due to interference with the emptying of the coronary venous system into the right heart. Bleeding the intact animal has little effect on the arterial pressure but reduces venous pressure, which results in an increase in heart rate which tends to facilitate the movement of blood from the venous to the arterial side; there is also an increase in respiratory rate and a rise in blood sugar. In the denervated heart the effects of high pulmonary resistance could be lessened by decreasing the arterial resistance (*i.e.*, the work of the heart) which resulted in a fall in venous pressure.

With regard to the administration of glucose and lactic acid, administration of lactate tends to decrease the utilisation of glucose by the heart; it might be better to give both together. Nevertheless injection of lactate appears to be more efficacious in recovering the failing heart. The heart prefers lactate to glucose if lactate be available. Furthermore lactate is more permeable than glucose, causes an increase in coronary flow and is more easily used for immediate combustion. The heart can tolerate high blood lactates, 500 mg. per cent. in the blood in no way interferes with the beneficial effects of lactate.

With regard to the nervous mechanism, interference produced a quantitative alteration. The work of Professor Brouha on the completely sympathectomised dog, adrenalectomised on one side and adrenal demedullated on the other side, has shown that after recovery the animal is still able to perform work. On the treadmill the animal is able to increase its heart rate with increased work, shows cardioacceleration with excitement and in fact reacts like a normal animal. It appears that there are accelerator fibres in the vagus which are capable of exerting their influence within a few weeks of total sympathectomy. Section of the vagi in the sympathectomised animal results in the disappearance of the accelerator response to exercise and other stimuli. The normal animal runs voluntarily on a treadmill as long as one likes to leave it, provided that it is supplied with glucose at regular intervals, *e.g.*, five minutes rest every 20 minutes. The sympathectomised animal is also able to run for prolonged periods. Trained animals will exercise themselves on a treadmill, jumping on and off as they feel inclined.

With regard to vitamin B_1, he had seen some of the work on this at Boston where there were patients whose cardiac disorders were said to be due to B_1 deficiency; however, he would rather not make any statements about this subject just yet.

Concerning the method of measuring the blood pressure in intact animals, he supposed the method referred to was that in which the degree of pressure exerted by a spring was sufficient to occlude the artery; the method was quite a reasonable one for rough measurements.

Cardiac muscle was not affected in the same was as skeletal muscle by lactic acid. He believed that cardiac muscle utilised lactic acid as fuel for immediate combustion and that glucose was used to maintain the glycogen store of heart muscle.

He feared that he was unable to comment on the rôle of acids or urea.

Storage and Shipment of Semen

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The possibility of keeping the semen of the various domesticated animals kinds alive and fertile outside the body is one of the greatest potential advantages of artificial insemination, and was foreseen by Ivanov[54], Hoffmann[45], Ishikawa, etc.

The storage and transport of semen are two different problems, somewhat interdependent and both aiming at :—

(*a*) The insemination of more females from each ejaculation ;

(*b*) The insemination of females at a distance from the sire.

In Italy, artificial insemination with stored semen (8 hours) was first practised by Pirocchi. He succeeded in obtaining pregnancy in the cow, but the foetus died in utero[88, 89].

At present, the problem of the storage of the semen of primates and birds outside the body, is far from being solved, and must be regarded as still in the experimental stage ; success may be achieved in future.

While good results have been obtained in tissue culture work (see Yamane[118]) the storage of sperms outside the body is rather difficult owing to their high cellular differentiation, the rapid dissipation of their vital energy charges, and their metabolic requirements.

The inability of the gametic cells, especially male cells, to multiply, and their lavish production from the testes suggest that they have a survival capacity quite different from other animal cells (Yamane[118], Gray[35], Engels).

Anderson's statement that male and female cells might retain their fertilizing power only up to 12 to 24 hours after ejection, seems to be subject to modification, when considering the results obtained by other workers who assume that the time of survival of the sperms varies according :—

(1) To the species of animal (Milovanov[9], Lambert[58], McKenzie[68], Walton[110], Letard[61], etc.), especially in relation to variations in the amount of accessory sexual gland secretions ;

(2) To differences in strain, breed, etc., and in individuals of the same breed (individuality, age, etc.), (Milovanov[8], Walton[110], Peli[81], Goetze[34], Hoecker[44], etc.), as well as to variations in an individual which depend on a variety of factors (food, health conditions, medical treatment, rest or sexual and physical overwork, season, etc.), (Goetze[34], Peli[80], Bonadonna[11, 1], Milovanov[9], Weber[112], Hoecker[44], etc.). The quantity and quality of the semen may be in some way affected by one or more of these factors, and storage so as to maintain fertilising power may be correspondingly affected ;

(3) To the method used in collecting the semen. For example, semen collected from the vagina of a living female is not so easily stored as semen obtained in other ways (Miller[70], Anderson[2], Palmer, Wester[114], Renket, Hustchenzeiter, etc.). Horse semen obtained from the epididymis and the "vas deferens" keeps longer than semen collected by means of the artificial vagina (Gonzaga and Valenzuela[33], Yamane[118]), owing to the presence of accessory gland secretions in the latter. Cattle semen collected by means of the artificial vagina (Zamboni[129], Werner[113], Poellmacher[90], Teich[106], etc.), keeps better than semen obtained by rectal massage ;

(4) To the technique of the treatment of the semen, with regard either to its immediate use or to its storage (protection from the air, dust, water, sun rays, etc.).

The optimum condition in which the semen may be stored outside the body would seem to require a physical environment similar to that within the male genital tract where the sperms live. However, it is impossible to create such an environment. Within the animal body the sperms are motionless in a medium with an acid reaction. This is a *p*H of 5·55 to 6·72 in the "cauda epididymis" and "vas deferens" according to Lanz[57] (*p*H 6·9 according to McKenzie, Miller and Bauguess, etc., Redenz[94], Roemmele[96], Oslund[77], Toothill and Young, Simeone and Young[105], Willet[115], etc.). According to Fukul, Heller, Moore, Shergin[102], McKenzie and Phillips[86], Simeone and Young[105], Phillips and Andrews[85], etc., Nature has facilitated sperm preservation within the body by the thermo-regulating mechanism of the scrotum.

It seems permissible to assume :—

(*a*) That the glycolitic functions of sperms are greater than their utilisation of oxygen in animals in which insemination has occurred (Redenz[94], Ivanov[55], McCarthy and Stepita[66, 67], Milovanov[72], Goldblatt[32], Bernschstein and Slovochotov[7], etc.), and consequently, while glucose is a useful source of energy for sperms, the intermediate products of metabolism (lactic acid) are likely to produce self-intoxication ;

(*b*) That the acid reaction of the medium (*p*H = 7—7·4) is likely to reduce glycolysis by the sperms (Milovanov[9], Carter[17], Letard[61], Roemmele[96], Miller[70], Phillips[84], Walton[110], etc.), below the toxic limits, while neutral reactions, and above all alkaline reactions, increase activity and motility of the sperms, and speed up metabolic processes and the rate of exhaustion of glucose, bringing about a condition in

which toxic metabolites are accumulated (Milovanov[9]).

(*c*) That similar effects may be produced by the secretion of the prostate added to the sperms during ejaculation (von Lanz[57], McKenzie and Phillips[86], Miller and Bauguess, etc.), as well as by the dilutors (Walton[110], Zagami[122,123,124,125,126,127,128], Milovanov[9], etc.);

(*d*) That the electrolytes present in these media possess activating properties (see Walton[9], Hammond and Asdell[41], Winstoner[116]), together with the risk of destroying the lipoid capsule (Milovanov[9], Marza[65], Bernschtein and Sokalova[6], Yamane[118], Ohi, Sato, Datwyler[22]), which may be regarded as a protective structure of the sperms. Substances such as chlorides, chlorates, nitrates, bromides, and iodides prove harmful to the lipoid capsule, while sulphates, phosphates, tartrates, citrates and acetates are likely to strengthen it by inhibiting colloidal absorption ;

(*e*) That it is important to achieve an optimum state of electrolyte balance to preserve sperms alive and motile and to prevent agglutination (which may occur at *p*H 3·0 (Walton and Kalwoyjski) or with a strong electrolyte concentration (Milovanov[9])) ;

(*f*) That the activity of the sperms is greatly reduced by lowering the temperature, though the effect of the medium on the sperm would in no way be affected ;

(*g*) That the semen is an organic medium in which putrefactive organisms will easily develop. These organisms are inimical to sperm life and also to storage, and they can only be controlled by lowering the temperature (Milovanov[9], Yamane[118], Anderson[2], Palmer, etc.).

Semen from animals having a "vaginal insemination" (cattle, sheep, goats, etc.), differs in quality from that of animals having a "uterine insemination" (horse, pig, etc.). In the former the amount of accessory gland secretion is scanty, but plentiful in the latter. The physiological activity of the sexual secretions, therefore, should not only be regarded as an auxiliary mechanical means of increasing volume, but also as a stimulus to the reproductive cells. These secretions affect akalinisation of the medium and an increase in the number of the electrolytes. Their continuous action upon the sperms consequently leads to the consumption of glucose, the destruction of the lipoid capsule, and finally to the death of the cells. (Miller[70], Gunn[39], Lush[64], Freiberg[27], Milovanov[9], Walton[110]).

Immobility of the sperms outside the body may be easily obtained in sheep semen (Milovanov[9], Walton[110]), since there is a high sperm concentration in a very little accessory gland secretion.

Cattle sperms, too, readily become motionless though not so quickly as sheep sperms (Milovanov[9], Walton[110]), and this accounts for its longer survival at room temperature.

Horse and pig semen collected by the usual methods, is the most difficult to store (Milovanov[72], McKenzie[68], Winters, Comstock, Cole, Green, Bulik[117], Walton[110], Lambert[58], Yamane[118], Capuz, Camici and Polestra[16], Pezzola and Rossi[83], etc.).

The problem of prolonged storage of the semen outside the body resolves itself into a consideration of the following points :—

(1) The avoidance of the harmful effects of electrolytes in the medium upon the lipoid capsule, which is most important for semen rich in accessory gland secretions ;

(2) The reduction to the lowest possible extent of anabolic and katabolic phenomena, thus rendering the sperms nearly motionless, the glycolitic process being just sufficient to keep the cells alive ;

(3) The maintenance of sufficient amounts of nourishing material (glucose) and of material able to neutralise as much as possible the toxic effects of the intermediate products of metabolism, thus effecting a balance of the H-ion concentration.

This end can be achieved practically by reducing the activity of movement of the sperms by lowering the temperature, by balancing the *p*H value, and, if necessary, by centrifuging the semen, especially horse semen (Walton[110], Winters, Comstock, Cole, Green, Bulik[117], etc.). In cattle the same ends are achieved by collecting by the massage method (Zamboni[129]).

Temperature

All authors agree about the necessity to store semen at a temperature lower than body temperature, which is harmful to the survival of the sperms (Ivanov[54], Hoffmann[45], Bruni[14], Pirocchi[88,89], and many others).

When the semen is to be stored for a short time (1 to 2 hours) it may be kept at room temperature (Letard[63], Milovanov[72], McKenzie[68], Peli[80], Lambert[58], Lebedeva[60], etc.).

To store cattle and sheep semen for a longer time, it is necessary to lower the temperature to 8-15° C., according to Walton[109], Komarev and Gladcinova[47], Vorobjev and Schneerson[107], Garcia Mata[30], Weber[112], Letard[62], Hoecker[44], Pribyl, Anderson[2], Shibata, Fuyoka, Murata, Nampa and Tomonori[103], Walton[110], Gunn[39], Shibata, Murata, Yabunaka, Hirabayashi, Ito and Kakinuma[104], Kharibullin[40], Miller[70], McKenzie[68], Perry[8], etc.), and to 0°C—0·5°C according to Bonadonna[12], Zamboni[129], Griffini[37], Peli[80], Schoettle[97,98], Kuhne[48], Palmer, Hatzioles[42], Moeckel[74], Lebedeva[60], Jordao, Gunn[39], Yamane[118], Milovanov[72], Lush[64], Hammond[40], Winters, Comstock, Cole, Green and Bulik[117], Cole[20], Fourt, Shaw, Gildow, Lambert[58], Datwyler[22], etc.

According to Milovanov[72], Hammond and Walton, and others, the optimum temperature for the storage of horse semen is 15°-17° C. in order to avoid too rapid swelling of the colloids and consequent destruction of the lipoid capsule.

Gonzaga and Valenzuela[33], Yamane[118], Ivanov[54], Wolf, Shinamura, Sato, Toma, etc., would appear to have obtained better results, even in storing horse semen, by lowering the temperature to 0°—2° C.

While some authors like Hatziolos[4] insist that temperatures below 0° C. are harmful to the storage of the semen, Jahnel is recently stated to have succeeded in storing human semen near to 0° C. without destroying the sperms' motility[53]. It seems, however, that Gellehem has obtained 23 per cent. of pregnancy by artificially inseminating bitches with semen stored at –13° C. (as quoted by Milovanov).

Most authors discuss the necessity of avoiding any sudden changes in the temperature (Fourt, Shaw and Gildow, Phillips, Shott and Gildew[87], Reed[95], Lambert[58], Graves, etc), and of gradually cooling the semen to be stored (Milovanov[9], Letard[6], Miller[70], Birillo and Puhaliski, Lambert[58], etc.), and warming it up gradually to body temperature before using it subsequently for artificial insemination (Schoettle[97], Letard[62], Milovanov[9], Miller[70], Winters, Comstock, Cole, Green, Bulik[117], McKenzie[68], Cole[20], Lambert[58], Katziolos[4], Anderson[1], Devuyet[23], etc.

Dilutors

According to some authors (Ivanov[54], Dschaparidse[26], Quinlan, Maré and Roux[92], Miller[70], Green, Winters, Comstock, Cole, Green and Bulik[117], Cole[20], Moeckel[74], Lebedeva[60], Anderson[1], Shimamura, Sato and Toma[118], Shibata, Murata, Yabunaka, Kumagai, Hirabayashi, Ito and Kaki[104], Khabibullin[46], etc.), the dilution of the ram's and bull's semen, even with small amounts (0.02 c.c. of dilutor to 1 c.c. of ram's semen, according to Milovanov) is very useful to its storage. Gluco-phosphatic solutions are generally preferred.

However, other authors (Bonadonna[1], Hoecker[44], Komarev and Gladcinova[47], Schoettle, Weber[112], Phillips[84], Gonzaga and Valenzuela[33], Hatziolos[42], Kuest[50], Griffini[73], Shibata, Fujioka, Murata, Nampa and Tomonori[103]) have not noticed any marked advantage in the storage of whole semen.

Phibyl, Gonzaga and Valenzuela[33], Milovanov[9], Winters, Comstock, Cole, Green and Bulik[117], Walton[110], Phillips[84], Yamane[118], Yamane and Kato[118], etc.), agree that horse semen is better stored when sulphate, tartrate solutions (with or without peptones) and tannin solutions are added to it. The storage of pig semen needs further study. Walton[110], Camici and Polestra[16], Pezzola and Rossi[83], Winters, Comstock, Cole, Green and Bulik[117] have found it very useful to centrifugate horse semen.

Ochi, Sato, Yamane[118], Milovanov[9], Miller[70], Lambert[58], etc., have found it very useful to add a small amount of glucose to cattle and sheep semen which is to be stored.

Liquid Paraffin

The "Cambridge" method of storage of the semen, widely used by most authors in various countries, involves covering of the sperm in a test tube with a thick layer of pure liquid paraffin. The advantages of this procedure are: (1) to prevent the oxidation of the semen; (2) to prevent its contamination from contact with the air; and (3) to fill completely the test tube in order to avoid any shaking of the semen and the formation of foam which, according to Yamane, is particularly harmful to the sperms.

Duration of Storage

It may be seen from the international literature that different results have been obtained concerning the duration of successful storage, according to the method of collection of the semen (vaginal method, sponge method, etc.) and to the methods of storage.

Most authors' results give the degree of activity of the sperms as a criterion of successful storage outside the body, but not all of them refer to their fertilising power after a period of storage more or less long.

Milovanov[9], Miller[70], Gunn[39], Valenzuela and Gonzaga[33], Yamane[118], Yamane and Kato[119], Lambert[58], Zamboni[123], Griffini[37], Walton[110], Bonner and Trulsson, etc., have succeeded in storing sheep, cattle, and rabbit semen for 50 to 120 hours in good conditions of motility. Other authors succeeded in obtaining pregnancy in females inseminated with semen stored as long as 15 to 50 hours. (Kusnetzov[5], Peli[79], Cugnini[21], Letard[6], Green, Quinlan, Maré and Classeus[93]). According to Winters, Comstock, Cole, Green and Bulik[117], Kulesenko[49], Kutnezov[51], Vorobjev and Schneerson[107], Walton[109], Prawochenski and Walton[91], Phillips, Schott and Gildow[87], Jordao, Hammond and Asdell[41], pregnancy was obtained after insemination with rabbit semen stored for 3 to 7 days.

The greatest successes are those concerning the shipment of cattle semen from Beltsville (U.S.A.) to Buenos Aires (Argentina), a seven days' journey covering a distance of 13,400 km. (birth of a calf); the shipment of sheep semen from Cambridge to Warsaw, a 51 hours' journey covering a distance of 2,400 km. (one birth and one abortion); the shipment of sheep semen from Warsaw to Milan (53 and 68 hours) (two pregnancies and two abortions after three months and a half); the shipment of cattle and sheep semen[30] from Milan to Addis Ababa

(about 100 hours) particularly important on account of the great difficulties met with (no inseminations); the shipment of semen from the Netherlands to England and *vice versa*, and between different districts in the U.S., etc.

Peli[78], Plank, Bonnier and Trulsson, Griffini[37], Shibata, Fujioka, Murata, Nampa, Tomonori[103], Shibata, Murata, Yabunaka, Kumagai, Hirabaiashi, Ito, and Kakinuma[104], Perry[82], etc., have found that the fertilising power of stored semen is gradually reduced in proportion to the length of the period of its storage outside the body.

Most of the authors suggest that it is best to store the semen as short a time as possible (30 minutes to 6 hours according to Milovanov[72], Goetze[34], etc.).

Below we give a series of the longest periods in which the semen has been stored successfully with regard to its motility (the fertilising power has not been ascertained):—

Goat semen 400 hours (Moeckel[74]; sheep semen 27 to 29 days (Lebedeva[60]) and 28 days (Olbrycht[76], Gunn[39]); sheep semen 209 hours (Weber[11]), 3 days (Pribyl), 368 hours (Kuest[50]); horse semen 96 hours (Gonzaga and Valenzuela[33]), 24 hours (Yamane[118]), about 90 hours (Camici and Polestra[16]), and even up to 114 hours (Pezzola and Rossi[83]) with previous centrifugation; cock semen 120 hours (Griffini[37]) and 8 days with 50 per cent. of fertilising power (Japanese authors[103]); rabbit semen 7 days (Walton[109]), and up to 160 hours (Hammond[40]), and so forth.

From the fertilising point of view, the best results ever obtained are: Sheep semen, stored for 98 hours (Goetze[34]), 96 hours (Hammond), 48 hours (Winters), from 31 to 200 hours (Phillips, Schott and Gildow[87]).

Cattle semen, stored from 1 to 48 hours (Walton[110]), 48 hours (Cugnini[21], Peli[79]), from 48 to 72 hours (Walton and Siebenga), 168 hours (shipment experiment from Beltsville to Buenos Aires), 5 to 18 hours (Jordão, Brazil, private letter).

Horse semen, stored from 1 to 2 hours (Ivanov[54]), from 5 to 7 hours (Sato[118]), from 20 to 25 hours (Shimamura, Sato and Toma[118]), and from 20 to 24 hours (Kato).

When for any reason the prescribed conditions of storage are interrupted, the semen left must be thrown away, as it is most difficult to regain the same conditions in which the sperms were previously stored.

Evaluation of Stored Semen and of Semen which is to be Stored.

All authors agree that semen which has to be stored especially for a long period must have excellent initial qualities (excellent activity, perfect morphology, ideal *p*H, absence of foreign bodies, etc.), must be collected by means of a perfect technique, carefully managed, and come from highly healthy males.

The evaluation of the semen in order to know its vitality and its fertilising power after a certain period of storage is still very difficult.

An examination of the stored semen must be made microscopically using the hanging drop method. The semen must previously be diluted with glucose solutions, allowing them to act upon the semen for a sufficient period of time (Bonadonna[12], Camici and Polestra[16], Lasagni[59], Cicogna[18], Weber[112], Walton[110], Hammond and Asdell[41], etc.). The motility of the sperms, as seen microscopically, must not be regarded as a definite sign of their fertilising power. This applies to stored semen as well as to fresh semen (Runge, Jasche and Pankov, Posner and Schoeckel, Reynold, Espinasse, Eggers, Cory, Walter, Williams, Savage, Lagerloef). However, sperm motility, being a sign of vitality, is always present in sperms capable of fertilisation, and therefore it may be regarded as one of the first essentials. (Yamane, Roemmele, Feiling.)

In the case of stored semen, the motility shown by the sperms when warmed, may only be transient, caused by heating or by the addition of a dilutor. If so, sperms may be unable to ascend the genital tract of the female, or they may fail to fertilise the ovum.

Like other Russian authors, Cicogna has suggested that estimation of the degree of survival of stored sperms may be made after they have been brought to room temperature. According to Walton the respiratory activity of the sperms may be an index of their fertilising capacity.

Stored semen may be regarded as partially or entirely deprived of its fertilising capacity when showing:

(*a*) Non-motility of all or nearly all sperms;

(*b*) Rotating and oscillatory movements of the sperms being more marked than forward progressive movements.

(*c*) Tendency to the rapid exhaustion of movement (especially progressive).

(*d*) Agglutination of the sperms; abnormal sperm morphology (headless, tailless, with rolled tails, etc.).

(*e*) Contamination with various organisms which makes the semen quite unfitted for inseminating purposes.

Effects Eventually Affecting Progeny

Among authors having obtained normal progeny from females inseminated with stored semen there are: Peli[8], Bonnier and Trulsson, Griffini[37], the Japanese authors[103, 104], Hammond[46], Yamane and Kato[118], etc.

Harmful effects on progeny produced by storage of sperm have also been suggested, but

much more work on this point is required. It might be assumed that only sperms which are entirely normal are capable of fertilising the ovum and producing vigorous healthy offspring. Our experiments on artificial insemination with stored semen are not yet sufficiently extensive to enable a conclusion being drawn. At the same time we may regard sperms which have been stored as being capable of fertilising, but incapable of producing a normal pregnancy. Fertilisation and early segmentation may occur but nidation or pregnancy at an early stage, may be interrupted. Later on, in other cases, abortion might take place.

Technique for the Storage and the Shipment of Semen

Semen may be successfully stored :—

(1) By using the Cambridge method ; collecting the semen in a long, narrow test-tube covered by a thick layer of pure sterile liquid paraffin. This test-tube should be fitted into a larger tube, and then into a thermos flask containing water and ice ;

(2) By fitting the large tube containing the test tube, wrapped up in cotton wool, into an elastic rubber pocket (Olbrycht[75, 76], Lambert[58], Garcia Mata[30]) ;

(3) By "gelatinising" the semen. The addition of gelatine to the semen is now being carried out experimentally in Russia (Milovanov, Nagorny, Sivokon, Malakhov[73]), though Weber had already observed that the semen could be stored by adding to it some agar-agar which increased the viscosity of the medium.

Olbrycht[76] suggests the use of dark glass test-tubes, and Yamane[118] the use of non-alkaline glass test-tubes. Some others (McKenzie[68], Letard[6], and Olbrycht[76]) suggest previously smearing the inside of the test-tube with vaseline.

For the successful shipment of the semen, it is necessary to avoid carefully any shaking, which is most harmful to the sperms, according to Yamane[118], Walton[110], Milovanov[9], and nearly all American authors, and to use thermos flasks in order to avoid any dangerous variation of temperature (Reed[95], Graves, Lambert[58], Fourt, Show, Gildow ; Phillips, Schott and Gildow[87]).

Personal Observations

At our Institution at Milan, those who have been concerned with the storage of semen are : Griffini[37], cock semen ; Zamboni[129], cattle semen ; Camici and Polestra[16], cattle, sheep, and horse semen ; Pezzola and Rossi[83], horse semen ; Schueler[99], sheep semen ; Lasagni[59], cattle and sheep semen ; Cicogna[18], cattle and sheep semen ; and other veterinarians.

The author has personally made many experiments on cattle, sheep, and goat semen. The technique of storage which so far seems the best is :—

Cattle.—When the semen has to be stored 1 to 2 hours it may be kept at room temperature (18-20° C.), provided it has been covered by pure mineral oil. The test-tube containing the semen should be wrapped in cotton wool and kept upright sheltered from draughts and sun rays. When the semen has to be transported, the test-tube, wrapped in cotton wool, should be fitted into a thermos flask, the walls of which have been previously warmed up to 20-25° C. When the semen must be stored for a longer period of time it should be cooled to 1°-5° C. The collection must be made as quickly as possible, the semen put into a test-tube 0·5 to 0·8 mm. in diameter, and covered with a layer of mineral oil previously warmed up to the same temperature as the semen (20-25° C.). Then the test-tube, carefully corked and wrapped in cotton wool, is fitted in a rubber pocket, and this is put into a thermos flask. The thermos flask may be kept in a refrigerator. Cattle semen collected by means of the artificial vagina is better stored undiluted.

Sheep and Goat.—The technique is the same as that described for cattle except for the addition, which is, however, not essential unless prolonged storage is desired, of a gluco-phosphatic solution (0·1 to 0·2 c.c. for each c.c. of semen) before storage.

Horse.—When semen will not be stored for more than 1 or 2 hours, the technique is the same as above, except for the addition of small quantities of dilutor (5 per cent. sulphate or tartrate). For longer storage centrifuging is advisable. Centrifuged semen may be stored according to the usual technique.

Birds, Dogs and Rabbits.—In principle, the technique of storage is the same.

We have not as yet noted any particular advantage from the addition to cattle, sheep, and goat semen of gluco-phosphatic, gluco-tartratic or gluco-sulphatic solutions.

Experiments made to store semen (whole, diluted, with or without vaseline) in hermetically sealed phials, or in gelatine capsules have not given satisfactory results. Gelatine capsules have proved useless and the same can be said concerning the experiments of gelatinisation of sheep and cattle semen.

We have succeeded in storing sheep semen which later became sufficiently active (4/5), for as long as 569 hours and 30 minutes, and cattle semen (3/5) for as long as 455 hours. Cattle semen with 5/5—4/5—3/5 activities was obtained after storing for over 200 hours (from 200 hours to 287 hours and 50 minutes).

With regard to the fertility of stored semen, the results of some experiments still in progress at Cravino Farm, Pavia, and Colombara Farm, Milan, are shown in the Table. (*Overleaf.*)

Table

No.	Cow's Name.	Semen used for Artificial Insemination.				Result.		Remarks.
		Duration of Storage (in Hours).	Method of Storage.	Characters of the Semen at Collection.	Characters of the Semen at Registration.	Positive.	Negative.	
1	Spadino	455 h.	G	4/5-D	3/5	—	Came on heat after 31 days	Came on heat twice successively after artificial insemination and once after natural mating
2	Rata	287 h. 50 m.	G	5/5-D	4/5	—	Came on heat after 44 days	Found eventually pregnant (by rectal examination)
3	Caporala	287 h. 50 m.	G	5/5-D	4/5	—	Came on heat after 43 days	*Idem*
4	Campesa	259 h. 30 m.	G	5/5-D	5/5	—	Came on heat after 31 days	Came on heat after 3 times successively after natural mating
5	Nella	215 h. 35 m.	G	5/5-D	4/5	—	Came on heat after 20 days	Sold owing to recurrent sterility
6	Ida	214 h. 25 m.	G	5/5-D	3/5	—	Came on heat after 19 days	Pregnant through artificial insemination with fresh semen
7	Rata	209 h. 50 m.	G	5/5-D	4/5	—	Came on heat after 44 days	*Idem*
8	Barbina	192 h.	G	5/5-D	4/5	Normal pregnancy	—	
9	Frana	140 h.	G	5/5-D	5/5	Normal pregnancy		
10	Morella	136 h.	F	5/5-SD	3/5	—	Came on heat after 22 days	*Idem*
11	Paiana	95 h.	G	5/5-D	4/5	Normal pregnancy	—	
12	Corosso	73 h. 25 m.	G	5/5-D	5/5	Normal pregnancy	—	
13	Vera	71 h. 45 m.	F	5/5-D	5/5	Normal pregnancy	—	
14	Cosera	67 h. 55 m.	G	5/5-D	5/5		Came on heat after 21 days	Sold owing to recurrent sterility
15	Passcrino	67 h. 55 m.	G	5/5-D	5/5	Abortion after 151 days	—	Positive Bang's disease
16	Marcella	66 h. 50 m.	G	5/5-D	2/5	Normal pregnancy	—	
17	Toscana	56 h. 10 m.	G	5/5-D	3/5	Abortion after 64 days	—	
18	No. 91	54 h.	G	5/5-D	2/5	—	Came on heat after 45 days	Pregnant through natural mating
19	*Romaprola*	52 h.	G	5/5-D	—	Normal pregnancy	—	Semen shipped by railway from Milan to Bologna
20	Burrasca	49 h.	G	4/5-D	2/5	Normal pregnancy	—	
21	Creta	48 h. 20 m.	G	5/5-D	5/5	Normal pregnancy	—	
22	Pigra	47 h. 50 m.	G	5/5-D	4/5	—	Came on heat after 21 days	
23	Veneta	38 h.	G	5/5-D	4/5	Normal pregnancy		
24	Corriera	30 h. 15 m.	G	4/5-D	4/5	—	Came on heat after 19 days	Sold owing to recurrent sterility
25	Pigra	30 h. 10 m.	F	5/5-D	3/5	Abortion after 64 days		
26	Asmara	30 h. 10 m.	F	5/5-D	3/5	—	Came on heat after 19 days	
27	Corosso	23 h. 45 m.	DP	5/5-D	4/5	—	Came on heat after 23 days	Re-inseminated (See No. 12)
28	Bruna	5 h.	F	5/5-D	5/5	—	Came on heat after 54 days	Eventually *Trichomonas* abortion
29	Flora	5 h.	F	5/5-D	5/5	—	Came on heat after 40 days	*Idem*
30	Gardenia	5 h.	F	5/5-D	5/5	—	Came on heat after 15 days	*Idem*
31	Filanta	4 h. 50 m.	G	5/5-D	5/5	—	Came on heat	Sold owing to recurrent sterility
32	Corva	4 h. 30 m.	F	5/5-D	4/5	—	Came on heat after 24 days	

Table—*continued*.

No.	Cow's Name.	Semen used for Artificial Insemination.				Result.		Remarks.
		Donation of Storage (in Hours).	Method of Storage.	Characters of the Semen at Collection.	Characters of the Semen at Registration.	Positive.	Negative.	
33	Bionda	4 h. 30 m.	F	5/5-D	4/5	Normal pregnancy	—	
34	Furba	4 h. 25 m.	F	5/5-D	5/5	Normal pregnancy	—	
35	Brusca	4 h. 25 m.	F	5/5-D	5/5	Normal pregnancy	—	
36	Fride	3 h. 45 m.	F	5/5-D	4/5	Abortion	—	Eventually affected by endometritis and treated accordingly
37	Argentina	2 h. 50 m.	G	5/5-D	5/5		Came on heat	Sold owing to recurrent sterility
38	Oslavia	2 h. 50 m.	G	5/5-D	5/5	Normal pregnancy	—	
39	Gardenia	2 h. 50 m.	G	5/5-D	5/5	Normal pregnancy	—	
40	Pernice	2 h. 10 m.	—	5/5-D	—	Normal pregnancy	—	
41	Albiona	2 h.	—	5/5-D	5/5	Normal pregnancy	—	
42	Ardita	1 h. 30 m.	—	5/5-D	—	Normal pregnancy	—	
43	Capra	1 h. 15 m.	—	5/5-D	—	Normal pregnancy	—	
44	Colonello	1 h. 15 m.	—	5/5-D	—	—	Came on heat after 49 days	Eventually *Trichomonas* abortion
45	Gay	1 h. 15 m.	—	5/5-D	—	Normal pregnancy	—	
46	Gallora	1 h. 10 m.	—	5/5-D	—	Normal pregnancy	—	
47	Merlo	1 h.	—	5/5-D	—	Normal pregnancy	—	
48	Volpino	1 h.	—	5/5-D	—	Abortion	—	
49	Gaza	1 h.	—	5/5-D	—	—	Came on heat after 23 days	
50	Spagnola	1 h.	—	5/5-D	—	Normal pregnancy	—	

Our observations are not very numerous, and at the time of our experiments the health conditions at the two farms were far from good (contagious abortion at Cravino and trichomoniasis at Colombara). For that reason it is not quite certain whether our failures, especially abortions and delayed recurrence of oestrus (31 to 54 days) should be ascribed to those pathological conditions.

In the table it is shown that no female inseminated from semen stored over 200 hours has conceived. However, it must be remembered that in the seven females the recurrence of oestrus has taken place irregularly (31 to 44 days), and that for two of them ("Rata" and "Caporala"), Prof. Gerosa had made a diagnosis of possible pregnancy after 38 to 40 days.

Up to 4 hours and 30 minutes, and 5 hours of storage the fertility rate has proved high (15 out of 23) especially when considering that among the eight females which came on heat again, three are suspected to have slipped owing to trichomoniasis, and two had been sterile for a long time.

Fertility of semen stored as long as 30 to 95 hours, too, has proved satisfactory (11 out of 17) among which were two cows affected by persistent sterility. In this experiment, there is included an insemination with semen shipped from Pavia to Bologna (52 hours of storage).

Finally, we notice two cases of normal pregnancy obtained with semen stored 140 to 192 hours.

Concerning the fertility of sheep inseminated from stored semen, our data as yet are of little value [one abortion after insemination with semen shipped from Poland and stored for 53 to 68 hours; one case of suspected regression of pregnancy; two ewes artificially inseminated with semen stored 5 hours; four ewes artificially inseminated with semen stored 7 hours and shipped from Milan to Monza (Santamaria Breeding Station)].

During our research work, as well as during that of our co-workers, we have noticed :—

(1) That semen showing excellent characteristics at the time of collection (generally at the second or third ejaculation in cattle) and coming from healthy males not sexually overworked, may be readily stored for longer periods of time.

(2) That the storage qualities vary greatly according to the individual, and to the season, etc.

Conclusions

On the basis of our present knowledge, and from the results obtained by many scientists at home and abroad, as well as from our personal experience, the problem of the storage of the semen may be still regarded as being in the experimental stage.

The possibility of storing semen so as to maintain its fertilising ability for a long period of time outside the body, depends firstly on the breed and species of the animal and especially upon the physiological characters of the sperms. Various biophysical, biochemical and bioelectrical conditions, as controlled or influenced by secretions of the accessory sexual glands, are of great importance. Variations occur due to strain, individuality, age, state of health (general and local), diseases (transient or chronic), feeding, rest periods, sexual and general activity, season of the year, and a lot of occasional factors occurring in the same individual, which cannot always be recognised.

The semen can only be stored :—

(*a*) When it has been collected by means of a suitable technique (we think the artificial vagina to be the best device) ;

(*b*) When it has been packed carefully and quickly, and when the same temperature is maintained throughout the period of storage ;

(*c*) When it shows optimum qualities of density, motility, absence of abnormal morphology, foreign cellular or pathological bodies, and when it has been collected from a healthy male at the second or third ejaculation. The male should also be well fed, neither physically tired nor sexually overworked, etc.

At the present time we think it advisable to avoid any attempt to state a " record " in the time of storage of the semen, since the limits of its fertilising power have not been sufficiently ascertained, especially with regard to the normal course of pregnancy. However, we do not intend by this to embarrass future progress.

The highest time limits of storage of semen which have been proved possible by the results obtained *in vivo* by us as well as by other workers are as follows :—

Cattle	semen	from	50	to	120	hours.
Sheep	,,	,,	75	,,	120	,,
Horse	,,	,,	12	,,	24	,,
Pig	,,	,,	1	,,	2	,,

However, from a practical point of view it is better to restrict the duration of storage to the following maximum times :—

Cattle	semen	from	12	to	30	hours.
Sheep	,,	,,	30	,,	50	,,
Horse	,,	,,	2	,,	6	,,
Pig	,,	Use immediately.				

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Living Tubal Ova of the Goat

E. C. AMOROSO, W. F. B. GRIFFITHS and W. J. HAMILTON*

(Department of Embryology and Histology, Royal Veterinary College, London)

In recent years our knowledge regarding early developmental processes in our domestic mammals has been enriched by valuable contributions on the living ovum of the sheep,[1, 2] cow,[3] pig[4, 5, 6] and horse.[7] Little or nothing, however, appears to be known of the mature ovum of the goat, nor have we found any records of previous observations on tubal ova in this form.

Krause (1837) described and gave measurements of three ovarian ova, from which Hartman[8] estimated the size of the living tubal ovum as being of the order of 140μ. Assheton's[9] earliest specimen (copulation age 5 days 20 hours) had already reached the uterine horn and was in the blastocyst stage. Tsukaguchi[10] described several stages of the goat's blastocyst (copulation age not known) the youngest of which corresponds closely with that of Assheton.

In the present paper we propose to describe a short series of ova recently obtained in the Department of Embryology of the Royal Veterinary College in the course of a more extensive investigation of the morphology and physiology of development in the goat. In securing these ova the methods used were essentially those devised in the Carnegie Laboratory for obtaining pig ova described by Heuser and Streeter. All the ova described herein were recovered from the Fallopian tube.

After recovery, photographic records were made of the living eggs in isotonic saline. Figures 1 to 4 illustrate the type of records obtained of eggs which had been washed out of the tube immediately before. Figure 1 shows the appearance of the living uncleaved, fertile ovum as seen by transmitted light (× c. 230). One notes the relatively opaque granular vitellus, almost completely filling the sharply delineated zona pellucida. Embedded in the latter a number of sperm heads are to be detected. As in all recently ovulated mammalian eggs the perivitelline space is small. In Figure 2 we have a two-celled ovum of the same post-coital age as that in Figure 1, but recovered from the opposite tube, and in this case as seen by reflected light (× c. 278). The white glistening blastomeres are markedly unequal in size. The four-celled ovum as seen by transmitted and reflected light is shown in Figures 3 and 4 respectively. The crosswise disposition of the pairs of blastomeres frequently found in other species is also apparent here, whilst the volume of the perivitelline space is definitely increased as compared with that of the uncleaved ovum.

Fig. 1.—Photomicrograph of living uncleaved fertile ovum of the goat, photographed in isotonic saline. Transmitted light. × c. 230.

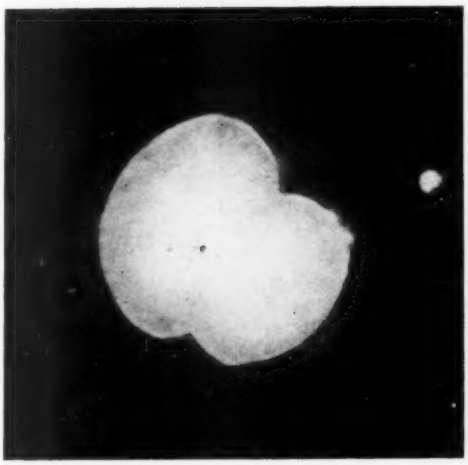

Fig. 2.—Photomicrograph of living two-celled goat egg, photographed in isotonic saline. Reflected light. × c. 278.

Brief protocols relating to these ova are as follows:—

(1) Goat 4 (Figures 1 and 2).

Animal bred four times between 9 a.m. and 11 a.m., November 19th, 1938. Killed 3.30 p.m., November 20th, 1938. Ovulation stigmata on

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both ovaries. Ovum (4a, Figure 2) recovered from right tube at 5 p.m., and completion of cleavage in this ovum observed under binocular. Ovum (4b, Figure 1) recovered from left tube at 5.25 p.m.

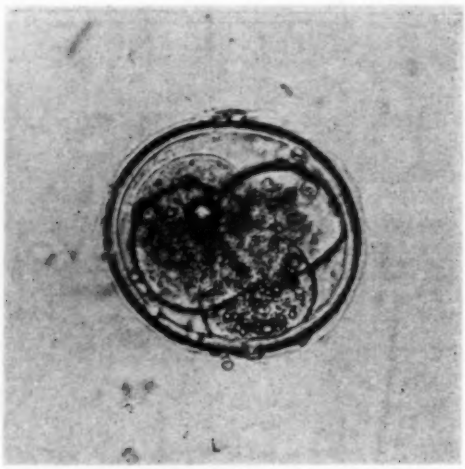

FIG. 3.—Photomicrograph of living four-celled ovum of the goat, photographed in isotonic saline. Transmitted light. × c. 230.

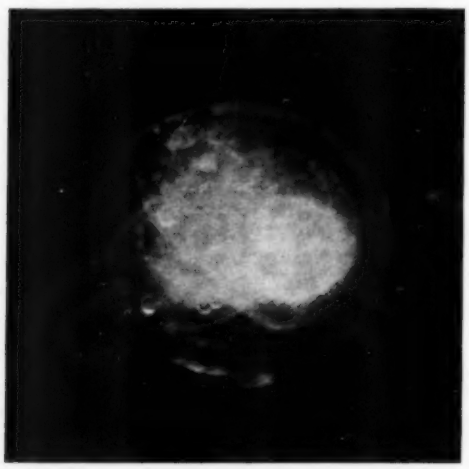

FIG. 4.—Photomicrograph of living four-celled goat egg, photographed in isotonic saline. Reflected light. × c. 278.

(2) Goat 5 (Figures 3 and 4).

Animal bred four times between 11.15 a.m. and 11.45 a.m., and twice between 4.15 p.m. and 4.30 p.m., November 23rd, 1938. Killed 9.30 p.m., November 25th, 1938. Ovulation stigmata on both ovaries. Ovum (5a, Figure 4) recovered at 10.45 p.m. Ovum (5b, Figure 3) recovered at 11.15 p.m.

It is concluded, therefore, that the age of eggs 4a and 4b is 31 hours post-coitus and the first cleavage takes place at this time, whilst the age of eggs 5a and 5b is 60 hours post-coitus.

In conclusion we append the following relevant measurements: —

Egg.	Mean Outside Diameter of Zona in Microns.	Mean Inside Diameter of Zona in Microns	Thickness of Zona in Microns.	Volume of Zonal Cavity in Cubic Microns.
4B	173·0	145·0	14·0	1,596,256
4A	174·0	145·0	14·5	1,596,256
5B	163·5	145·0	9·25	1,596,256

All the measurements given are based on photographs similar to those in Figures 1 to 4.

We are largely indebted to our technician, Mr. J. Hancock, for much help in the preparation of the microphotographs illustrating this paper.

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The Department of Agriculture for Scotland announces that, to provide information as to reliable sources from which stock of good quality may be obtained, with a minimum of risk as regards disease, it is again prepared to compile and issue a register of accredited poultry breeding stations in Scotland. It is proposed to recognise for the purpose of the free veterinary service to be provided under Section 24 of the Agriculture Act, 1937, poultry breeding stations accredited or accepted on probation under this scheme.

The Veterinary Record

August 19th, 1939.

Animals and Air Raid Precautions

As far back as 1936, representations were made individually by the National Veterinary Medical Association and the R.S.P.C.A. to the Home Office in connection with the promulgating of measures to protect our animal population in the event of a national emergency.

In response to these overtures a committee composed of Home Office officials and veterinary surgeons was appointed, but not until the crisis of September of last year and the formation of the National Emergency Committee of the N.V.M.A., were active negotiations undertaken, whereby the two committees became merged in January last, and entrusted with the work of compiling a handbook of advice and instruction for the information of stock-owners and the general public.

As a result of the committee's labours, Handbook No. 12 " A.R.P. for Animals " was issued last month by H.M. Stationery Office, price 3d. Acknowledgement is due to the R.S.P.C.A. for useful material supplied in this connection.

To carry into effect the provisions and recommendations set forth therein, the assistance of the animal welfare movement has been invited, and its prompt acceptance has resulted in the formation (as announced elsewhere in this issue) of the National Air Raid Precautions for Animals Committee (N.A.R.P.A.C.) under the Chairmanship of Mr. H. E. Dale, C.B., a former permanent Assistant Secretary of the Ministry of Agriculture, and whom the Lord Privy Seal has himself nominated.

On N.A.R.P.A.C. falls the responsibility of producing a workable scheme applicable to urban and rural areas, and on this task the committee is now earnestly engaged.

To appreciate the magnitude of this undertaking the following figures of the animal population of the country are quoted:—

Farm animals, 37,500,000;
Poultry, 56,250,000;
Dogs and cats, 6,000,000 to 7,000,000 (a conservative estimate).

Of this grand total there are within the 28 boroughs of the Metropolitan area 73,000 horses, cattle, sheep and pigs, and approximately 2,000,000 dogs and cats.

If, with London as a basis, a workable scheme for the protection and care of the animals within its boundaries can be evolved, modified schemes to meet the requirements of other cities and towns could be framed.

The practitioners in London available to lend professional aid are but 100 strong, but with the willing co-operation of the societies of the animal welfare movement, with their widely distributed clinics and trained personnel, together with the help of a trained band of voluntary helpers, it is considered that an effective and adequate organisation could be created. The claims of the rural areas too will not be forgotten, and will receive attention immediately the problems of the congested and evacuable areas have been dealt with. Suffice it to say that it is unlikely that farm animals would be considered as a primary object of hostile attack, and their normal dispersal confers comparative immunity. This, of course, does not apply to any concentration of store cattle.

It is but right that tribute should be paid to the animal welfare movement which has already supplied much useful information to the public on the care and protection of their animals in the event of an emergency.

The veterinary profession, always in the forefront of the struggle for the mitigation of animal suffering, await with anticipation the scheme now in preparation, and how best the services of the veterinarian can be employed. There can be no doubt that much will be expected of him, but all concerned in the welfare of animals may rest assured that he can be relied upon to be prepared to meet whatever emergency may arise.

To us with our special knowledge of animals, their needs, and their management, the country looks for guidance at this time, and everyone who does what he can to make N.A.R.P.A.C. a living organisation for the benefit of the nation's animals, will be serving his country well; upholding at the same time the dignity and prestige of our profession.

When the history of our own times comes to be written, we may be certain that the historian will have something to say about the work which was done for the protection of animals when the whole country was preparing to meet any emergency.

CLINICAL COMMUNICATION

A Case of Intestinal Strangulation in a Cart Horse

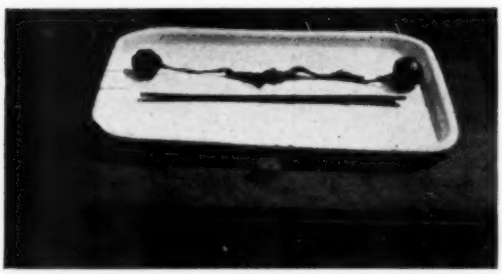
MAURICE KIRK, M.R.C.V.S.
BICESTER

Subject.—A ten-year-old cart horse.

History.—The horse did a normal day's work on the farm, and was fed and turned out at five o'clock. He trotted off as usual and began to graze. At nine o'clock that evening he was noticed to be standing quietly, not attempting to graze, and apparently asleep.

Nothing was suspected to be amiss and no veterinary advice was sought. Next morning the farmer found the horse dead, and suspecting plant poisoning he requested a *post-mortem* examination.

Post-mortem Examination.—This revealed strangulation of three loops of small intestine by a cord of mesenteric tissue which had a ball of what on section proved to be encapsulated fat attached to either end; these balls of fat had become entwined, and had thus formed a knot. There was very little inflammation to be seen except directly under the cord, after its removal, and I assume that death was due to toxic absorption.



The photograph shows the specimen exactly as removed from the body cavity. The metal measure beneath is twelve inches long.

COD LIVER OIL *v.* CONCENTRATES

Statements recently made that cod liver oil is being largely replaced by halibut liver oil and concentrates of vitamins A and B are being vigorously contested by British Cod Liver Oil Producers (Hull), Ltd., who claim that cod liver oil remains by far the largest and most significant additional source of vitamin A available for human nutrition. For medicinal purposes alone its consumption in this country, according to the figures given in the *British Medical Journal* (July 29th, 1939, page 264) exceeds 2,000 tons per annum, a figure which is stated to represent many times that of the amount of all other fish liver oils and concentrates consumed, both in tonnage and in vitamin A supplies.—*Pharm. J.*

ABSTRACTS

[The Effect of Sodium Amytal, Sodium Barbital, and Nembutal on the Electrocardiogram. HAFKESBRING, R., MACCALMONT, W. (1938.) *J. Pharmacol.* **64.** 43-49. 3 tables. (10 refs.).]

The electrocardiograms of dogs and cats were studied before, during, and after the administration of sodium amytal, sodium barbital, and nembutal, to determine the effect on the myocardium during anaesthesia, the degree of recovery of the electrocardiogram to normal, and the presence or absence of cumulative effects.

Before administration, several normal tracings were taken on consecutive days. The drugs were injected intraperitoneally and electrocardiograms were recorded at 10-, 20- and 30-minute intervals, and then every hour until recovery.

The only cardiac effects were an increase in heart rate and a decrease in sinus arrythmia. Nembutal in anaesthetic doses does not affect rhythm or conduction. It causes a much greater increase in heart rate in cats than in dogs. Anaesthesia is more prolonged in the cat, and the maximum increase in heart rate occurs later, or at a time when dogs are beginning to recover. In every case the temperature is greatly decreased during anaesthesia, but returns to normal on recovery.

When lethal doses of any of the drugs are given, death is due invariably to respiratory and never to cardiac failure.

Cardiac effects are transient, and records taken on the day following anaesthesia are normal. Repeated anaesthetisation over a period of eight months in two cases had no ill effect on the health of the animals. There was no evidence of tolerance nor of cumulative effects.

D. D. O.

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[Collection of Semen of the Bull. GONZAGA, A. C. (1938.) *Philipp. J. Anim. Indust.* **5.** 369-376. 5 plates. (4 refs.).]

Two models of artificial vagina, the Russian pattern of Kamarov and Nagaev (1932) and the British type of Walton (1933) are described. Directions are given for their use for collecting semen from bulls. Both have given excellent results.

The first successful collection in the Philippines was made in 1937 when 5·5 c.c. of semen was obtained from an Ayrshire bull. In all instances practically pure semen, and all the ejaculate of the act, has been collected.

D. D. O.

[The Broncho-Dilator Action of Magnesium and its Antagonistic Action (Dilator Action) against Pilocarpine, Histamine, and Barium Chloride. Haury, V. C. (1938.) *J. Pharmacol.* **64.** 58-64. 2 figs. (8 refs.).]

The action of magnesium sulphate as a broncho-dilator and as an antagonist to broncho-constrictor drugs was studied by the perfusion of excised guinea-pig lungs. It was found that the addition of the drug to the perfusate increased the perfusion rate from 20 to 45 per cent. Histamine decreased perfusion rate by 82 per cent., but with magnesium sulphate added this decrease was reduced to 33 per cent. Pilocarpine gave reduction figures of 55 per cent. and 27 per cent. respectively. Magnesium decreases the time of recovery from barium constriction by 75 per cent.

These figures are of moment in view of recent reports on the value of magnesium in asthma (Rosella and Plá: *Prensa méd. argent.* 23. 1677) and in anaphylaxis (Delbet and Palios: *Bull. Acad. Méd. Paris.* 117. 96; and Lumière and Monchal: *C. R. Biol.* 124. 178).

D. D. O.

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[The Induction of Oestrus in the Ewe. Anderson, J. (1938.) *Vet. J.* **94.** 328-334. (12 refs. 2 tables.).]

Comparatively little work has been done on the effect of injecting "oestrin" into the ewe. In this paper the author gives an account of work carried out in Kenya on Merino ewes. The intramuscular injection of oestradiol benzoate ("Dimenformon" Organon) induced heat in 84 (74·3 per cent.) of 113 ewes during the normally anoestrous period when the ewes are suckling lambs. The optimum dose was about 5,000 to 6,000 I.U. Heat appeared in the majority of cases in one to five days following injection, but always within 21 days. An interesting result was that the induction of oestrus by this means caused the resumption of the normal oestrus cycle in a large number (73 out of the 84) of the injected ewes, probably due to the effects of the injection on the gonadotrophic activity of the anterior pituitary. Ovulation probably did not occur at the first oestrus following injection, but it seems that once the oestral cycle has been re-established, ovulation occurs probably at the second, or subsequent heat periods.

N. J. S.

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[Ascarid Infestation, Rickets, and Luxation of the Hip and Knee of the Dog. (Trans. title.) Wirth, and Pommer, A. (1939.) *Wien. tierärztl. Mschr.* **26.** 38-41.]

A litter of six "Boxer" puppies all developed clinical signs of bronchial catarrh at four weeks old and ten days later passed Ascarid worms in the faeces. Treatment with Kebal II (oil of chenopodium) quickly rid four puppies of worms, but one was specially heavily infested and recovered only slowly. At eight weeks old it was well enough to be sold, but seven days later developed general paralysis and dragging of the hind feet. Chenopodium again freed it of worms, but it developed disturbances of movement and atrophy of the muscles of the pelvis and hind feet. Clinical and X-ray examination showed rachitic changes in the bones, which are described in detail. One X-ray photograph of these and one of the dog itself illustrate the paper. The authors conclude that on both sides the dog had rickets and luxation of the hip-joints forwards and upwards and of the knee-joints upwards and its attempts to walk had contributed to these. The bronchitic symptoms were due to migration of the Ascarid larvae from the blood into the lungs. The species of worms present are not stated.

G. L.

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[Rotational Grazing in the Prevention of Soil Erosion. Staples, R. R. (1937.) Ann. Rep. Dept. of Vet. Sci. and Anim. Husb., Tanganyika. 36-41.]

Great emphasis has been laid on the value of rotational (deferred would be a more correct term) grazing schemes in solving the erosion problems associated with overstocking. Under the tropical conditions of East Africa, bare and eroded pastures tend to recover quickly, when protected each year from grazing for three or four months during the growing season. Unfortunately, it is not always possible to protect pasture in this way, and the author outlines certain schemes designed to suit the local conditions were communal grazing is carried out, *viz.*:—

(1) Seasonal movement of stock. This scheme, where practicable, is easy to apply and has advantages in the control of certain diseases of stock, notably tick-borne East Coast fever. From the veterinary point of view, however, it may involve measures against tsetse fly.

(2) Division of the home pastures into eroding and non-eroding areas, the former being reserved for use only during the dry season.

(3) Deferred grazing. In this system the pastures are divided into two areas which are grazed more or less alternately according to a carefully regulated plan.

The remainder of the report deals with the progress of grazing schemes in various parts of the Territory.

N. J. S.

A Government Committee has been appointed in Southern Rhodesia to administer a Livestock Improvement Scheme. Its main task will be concerned with applications for grants and loans towards the purchase of bulls.

VICTORIA VETERINARY BENEVOLENT FUND

MEETING OF COUNCIL

A meeting of the Council of the Victoria Veterinary Benevolent Fund was held at 10, Red Lion Square, London, W.C.1, on Tuesday, July 4th, 1939, when the following members were present: Messrs. G. H. Livesey, G. P. Male, Arnold Spicer, Mrs. E. M. Wooldridge, Professor G. H. Wooldridge, Mrs. W. G. Wragg and Captain W. G. Wragg.

In the absence of the President, Mr. G. P. Male, Vice-President, took the Chair.

The minutes of the previous meeting, held on April 12th, 1939, having been published, were taken as read and signed as correct.

Letters of apology for absence were received from Mr. G. H. Locke, Lieut.-Colonel P. J. Simpson and Mr. W. Jackson Young.

Secretary's Report

The following report of the Secretary was read and approved:—

Since the previous quarterly meeting, the following new and increased subscriptions and donations have been received:—

Subscriptions

	£	s.	d.
G. Briggs		10	6
Miss A. M. Catchpole		10	6
J. T. Clanchy (increased by)	1	1	0
S. Conway	1	1	0
M. Darby		10	6
G. D. W. Davidson		10	0
A. H. Dawson	1	1	0
J. J. English		10	6
W. J. Henigan	2	0	0
W. Hepburn	1	1	0
Watkin James		10	6
A. Kerr		10	0
J. A. MacCann (increased by)		10	6
D. F. McCarthy		10	6
D. B. Mahony		10	6
G. T. S. Mower		10	0
J. F. Nally		10	6
H. Purcell		10	6
F. St. G. Sleith		10	6
Captain W. A. Smith		10	6
Veterinary Medical Association of Ireland	153	0	0
	£167	0	0

Donations

	£	s.	d.
Collecting Boxes.			
Central Veterinary Society	2	19	3
Animal Diseases Research Association	8	0	
Derbyshire Veterinary Association	3	6	0
	6	13	3
John Brown, Perth (legacy)	1,000	0	0
W. Collinson (life member)	10	10	0
Dumfries and Galloway Division, N.V.M.A.	1	1	0
A. S. Ferguson	2	0	0
London Sporting Spaniel Society (*per* H. Stainton)	1	1	0
Chas. Pierce (non-member)	1	1	0
J. O. Powley (collection by Mrs. Powley)	12	2	0
N.V.M.A. (proportion of insurance commission)	15	10	6
W. Rhodes	1	1	0
R.V.C., Students' Union Society	5	5	0
W. W. Smart	1	1	0
Guy Sutton	25	0	0
J. N. Zarpas (*per* B. Best)	2	2	0
	£1,084	7	9

The Secretary was instructed to express the grateful thanks of the Council to the Veterinary Medical Association of Ireland for their generous contribution and also to the other donors.

Life Membership.—It was unanimously resolved, "That Mr. W. Collinson be elected a Life Member of the Fund."

Cases

185.—Daughter of member. Aged 66. Now in St. Monica's Home, Westbury-on-Trym. No income. The Executive Committee recommended that a small grant be made for incidental expenses, and it was resolved, "That a grant of £1 10s. 0d. per quarter be made in this case."

197.—Widow. Aged 40. Five children. Applicant has been ill in hospital. Information was received as to the employment of the elder children, and the grant of £1 10s. 0d. was reduced to £1 per week.

199.—Widow. Aged 41. Eleven children under 17 years. It was resolved, "That the grant of £1 10s 0d. per week be continued but that the Executive Committee have power to increase the amount to £2 if thought desirable."

220.—Wife, aged 37, of M.R.C.V.S. now in mental home. The grant of £1 per week having been discontinued on account of the applicant having obtained employment, the applicant made a further request for a grant to enable her husband to have special treatment. The Secretary submitted correspondence showing that the proposed treatment, which was costly, was of doubtful efficacy in this case, and it was resolved, "That no grant be made."

222.—M.R.C.V.S. Aged 70. Unemployed, and receiving temporary grant from British Legion.

N.V.M.A. DIVISIONAL REPORT

Central Veterinary Society

The prospect of an extended discussion on the subject of the rapprochement between the Royal College of Veterinary Surgeons and the People's Dispensary for the Sick Animals of Poor Persons, now so widely exercising the minds of members of the profession, and also of hearing an address on a topic so much "out of the ordinary" as "Some recent advances in the physiology of cardiac function," from Professor Yule Bogue, attracted a good attendance at a meeting of the Central Veterinary Society held at the Conway Hall, W.C.1, on the evening of Thursday, May 4th, 1939.

The Chair was occupied by the President (Mr. Nevill S. King) and there were also present Miss M. L. Bingham, Mr. W. Brown, Dr. Fred Bullock, Mr. H. E. Bywater (Hon. Secretary), Mr. W. H. Chase, Mr. J. J. Davies, Capt. H. S. A. Dunn, Mr. J. Francis, Mr. C. Formston, Dr. Tom Hare, Messrs. S. L. Hignett, S. F. J. Hodgman, J. W. H. Holmes, Miss R. E. Holman, Miss D. Howell, Messrs. H. D. Jones, Herbert King, H. C. P. King, Major Hamilton Kirk, Mr. G. C. Knight, Lt.-Colonel G. P. Knott, Capt. G. Dunlop Martin, Professors J. McCunn and W. C. Miller, Dr. R. F. Montgomerie, Messrs. C. W. Ottaway, W. Perryman, N. J. Scorgie, Miss K. M. Sanderson, Miss M. Stewart, Mr. Alex. Thomson, Capt. W. K. Townson, Miss O. Uvarov, Mr. E. G. White, Mr. A. N. Worden, Mr. C. E. Woodrow, Professor G. H. Wooldridge, Dr. W. R. Wooldridge and Professor J. G. Wright. The following were present as visitors: Miss D. H. Craddock, Miss M. G. Hignett, Mr. J. M. Laing, Miss H. Neve, Miss M. M. Skinner, Miss R. Teverson and Mrs. E. I. Thomson.

The minutes of the March meeting of the society, having been published in the *Veterinary Record*, were taken as read and were confirmed and signed.

Correspondence

(1) From the following fellows, apologising for their inability to attend: Dr. W. P. Blount, Capt. J. C. Coleman, Professor T. Dalling, Lt.-Col. H. Greenfield, Capt. J. F. Macdonald, Capt. S. J. Motton, Mr. H. L. Roberts, Mr. J. S. Steward, and Capt. J. F. D. Tutt.

(2) From Lt.-Colonel T. E. Burridge, of Frinton-on-Sea, intimating that he wished to resign from the society on account of the fact that he had been unable, since he was elected a fellow, to attend any of the meetings.

The resignation of Colonel Burridge was accepted with regret, on the proposition of Mr. Jones, seconded by Mr. Cyril King.

(3) From the General Secretary, N.V.M.A., inviting information from any member of the Division able to supply information as to the experience of any of his clients who may have used so-called "remedies" for the treatment and cure of contagious abortion and sterility in cattle.

(4) From the General Secretary, N.V.M.A., enclosing a copy of a Scheme for an A.R.P. Service for Animals which the National Emergency Committee of the Association have submitted to the Air Raid Precautions Department of the Home Office for adoption. The letter continued:—

"The Home Office have decided to refer the scheme to the three largest animal welfare societies (R.S.P.C.A., National Canine Defence League, and P.D.S.A.) with the object of ascertaining to what extent these societies are prepared to assist in providing necessary personnel, funds and equipment.

"As, however, the scheme envisages setting up an organisation for animals as part of the general A.R.P. scheme under local authorities and is therefore a matter for local arrangement ultimately, the Association's Committee hope that your Division will see its way to get into touch at an early date with the various local authorities in its area with a view to pressing for the organisation of an A.R.P. Service for Animals according to the needs of each locality on the lines outlined in the Association's scheme. It might also be advisable to approach the local branches of the animal welfare societies on the matter.

"The Committee venture to recommend the appointment by your Division of Local Emergency Committees, one for each county administrative area, and one for each borough, to deal with the foregoing suggestion and to which could also be referred other schemes relating to national defence in which the co-operation of the profession may be indicated.

"It has been suggested that a Local Emergency Committee might include (*a*) the officers of the Division *ex-officio*; (*b*) all members of the Division living in that area other than officers of the Ministry of Agriculture; (*c*) the veterinary Superintending and Divisional Inspector of the

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It was resolved, "That a grant of 10s. a week be made until the applicant is entitled to the Old Age Pension."

223.—M.R.C.V.S. Qualified in 1880. Wife and one child, aged 4. Now in financial straits owing to diminished practice. On the recommendation of the Executive Committee a temporary grant of £1 per week was made.

234.—Wife of M.R.C.V.S., now in mental home. Application for assistance towards charges made by the Public Assistance Committee. On the recommendation of the Executive Committee a grant of £5 per month was made in this case.

Investments.—The Treasurer reported that he had invested the sum of £1,000, being the legacy of the late Mr. John Brown, of Perth, in the purchase of £1,083 18s. 0d. 3½ per cent. War Loan.

Ministry of Agriculture and (*d*) a representative of the veterinary school or veterinary laboratory in the area. (As whole-time officers of the Ministry are liable to be moved to other districts, it has been represented to the Committee that it would be inadvisable for that reason to appoint the Superintending or Divisional Inspector to 'key' positions on Local Emergency Committees. This does not mean that they should not be appointed to serve on these committees; indeed, it is felt that they could be very helpful in making the necessary preliminary arrangements.)

"The Local Emergency Committee of a county might seek the approval of the Divisional Inspector of the Ministry for his office to serve as the headquarters of the committee, and it might be regarded as one of the functions of the committee to collaborate with the Superintending and Divisional Inspectors on such emergency duties as may be required by the Ministry."

Dr. Wooldridge moved "That this Division expresses its agreement with the policy outlined and that our executive officers act as the Local Emergency Committee in this matter."

Mr. Cyril King seconded the motion.

Dr. McCunn expressed the view that the motion placed too great a task on the executive officers, and the hope that a committee would be appointed.

Dr. Wooldridge having replied that, if his motion were agreed to, the executive officers could appoint such a committee if they thought fit to do so, the motion was put to the meeting and carried unanimously.

(5) A further letter from the General Secretary of the N.V.M.A. relative to collaboration between the profession and animal welfare societies.

It was agreed that consideration of this letter should take place on the related later item of the agenda.

Military Service Bill.—Presentation of the correspondence having been completed, Dr. Hare rose to say that there was a question which had arisen which was of urgent significance and required the attention not only of Divisions but certainly of the executive of the "National" at once. With the passing of the new Military Service Bill they would be confronted with this position, that veterinary students under the Act would be liable to be called up for service. That was rather a serious question, and he did not know whether it might not be wise for the Society to urge the executive of the "National" to enquire whether, in collaboration with the Royal College of course, any concessions could be obtained now that the Bill was actually before Parliament. Because some, if not all, students between the age limits of 20 and 21 would be in their third year and possibly some might have got to their fourth year, it was conceivable that the Government might consider such senior students being exempted from the provisions of the Bill. It was not a matter that could be left till the next Council meeting of the "National."

Professor Wooldridge pointed out that this matter had been taken up urgently by the Royal College: As all veterinary students were registered with them it fell within their province. He felt, therefore, that no advantage would follow from referring the matter to the "National," under these circumstances.

The meeting concurred in this view.

Fellowship Nominations.—The following were nominated for election as Fellows of the Society: Mr. H. T. Matthews, 10, Whitehall Place, S.W.1 (proposed by Mr. J. S. Steward, seconded by the Hon. Secretary); Mr. C. W. Abrams, Wanstead (proposed by Professor Wooldridge, seconded by Dr. McCunn), and Mr. W. Roach, Royal Veterinary College (proposed by Mr. Worden, seconded by Dr. McCunn).

Representatives to Council, N.V.M.A.—The President informed the meeting that the Society were entitled to seven representatives on the Council of the N.V.M.A. The Council of the Society had given consideration to this matter and had drawn up a list, but he was open to receive other nominations.

The Council's list having been announced and several additional nominations made, a ballot was taken and the following were declared elected: The President, Dr. Tom Hare, Dr. McCunn, Professor Miller, Mr. Ottaway, Mr. Scorgie and Mr. White.

Morbid Specimens and Cases of Interest

Mr. E. G. White said that a very unusual and interesting specimen was recently received at the laboratory and was illustrated by the two museum preparations he had brought. The left lateral lobe of a pig's liver, weighing 1,400 grm. consisted largely of cystic cavities packed with a gritty material comprising bile pigments and salts, transparent grit, and a few grains of wheat and oats. The cavities were found histologically to be formed of dilated and thickened bile ducts. The grit was similar to that found near the Cornish clay pits. The specimen was found in the course of routine meat inspection at St. Austell, in Cornwall. The carcase weighed 152 lbs. and the animal, which was seven months old, was one of a litter of nine and a "nestlebird," *i.e.*, it failed to fatten properly. The only other lesions found at inspection were a few abscesses containing a creamy pus in the liver, of which only the left lateral lobe appeared to contain grit. No very definite information was obtainable relative to the gall bladder, but it was fairly certain that it was normal.

Of the 500 grammes of material within the dilated bile ducts, about half was composed of grit and this and the oat and wheat grains

could only have gained access by the bile duct from the duodenum. "Joest, in his well-known encyclopaedic text," said Mr. White, "records a similar case in which the liver contained a large amount of sand. The opening of the bile duct in the pig is said to be ventral in position when the animal is standing and it is probable that foreign material may gain access under the inflence of gravity, especially if the bile duct opening is dilated, *e.g.*, by the passage through it of Ascarids. It is remarkable that there was no record of grit being found in the gall bladder or the other liver lobes."

The museum specimens showed a portion of the affected lobe of the liver and some of the material found within it, including oat and wheat grains.

He was indebted to Mr. Francis le Friend, Meat and Food Inspector, St. Austell Urban District Council, for the specimen and for permission to report on it.

Major Kirk said that he had been wondering if there was any peristalsis down the bile duct and, if so, whether anything could actually go "against the stream."

Mr. White replied that he must accept that possibility unless Major Kirk could explain how the oat grains and gravel got into the liver in any other way.

The Hon. Secretary observed that he had incised the bile duct in more ox livers than he cared to state during meat inspection, over a matter of 15 years. Some years ago he found that he had made examinations on 100,000 carcases. All the bile ducts were excised—and he could say that he had never seen anything like this in his experience. Whenever he had found any collection of material in the bile ducts—usually in bovine livers—it had always been accompanied by liver flukes and the deposit had been one of ordinary bile salts. He submitted that the condition shown in the specimen was very rare indeed.

Dr. Hare said he would like to suggest that the possible mechanism by which the oat grains were taken up into the bile duct and gall bladder would be through the passage of *Ascaris* worms up the duct. That was a not uncommon phenomenon—for the worm to pass into the bile ducts and actually subsequently to pass out again. He thought a great deal of the deposit could be accounted for as a consequence of the inflammation of the walls of the bile ducts themselves, but the foreign material could very readily be taken up by a massive invasion with *Ascaris*. He recalled one specimen in which they had a very heavy infestation of the gall bladder and ducts, in which they found a piece of metal right up in the main bile duct. As they probably knew, there were at the Royal Veterinary College several specimens mounted of worms in the bile duct.

The President enquired if there was any history of evidence of occlusion of the bile duct, any suggestion of icterus.

Mr. White replied that there was no icterus, adding that it had been recorded that two grammes of sand had been found in the liver of a pig kept near the sea.

Major Kirk said that he wished to bring forward, and if possible to gain information upon, the case of a Sealyham to which he was called because it had commenced to show very rapid respiration. She was an 18 months old bitch, had been in oestrum three weeks previously and he could find nothing at all to account for the greatly accelerated respiration. There was no question of the heart being implicated—the lungs were not at that time implicated—everything was negative. This went on for three days, during which the very rapid respiration never ceased. Naturally, the owner was very concerned, and so was he.

As he was not making any headway with the diagnosis the lady owner sent the dog to the Royal Veterinary College and apparently it came back still without a diagnosis. On the following morning he went to see the dog again and he thought that, with the stethoscope, he could detect a definite bronchitis. The ordinary treatment was applied and on the fifth day the rapid respiration died down and was now normal. On the third day the pulse was 172 and he was afraid that the heart was going to give out. He was wondering if anyone could offer any reason for the occurence of that respiratory abnormality: he himself was wondering if there was any connection with the sex glands, because the owner's secretary had told him that the bitch kept on making a bed. It was suggested to him that had he given the animal calcium intramuscularly the whole phenomenon would have died away: he presumed that that was based upon the supposition that it was an acidosis.

The Rapprochement between the R.C.V.S. and the P.D.S.A.P.

There being no further contributions to the clinical discussion, the President called upon the Secretary to read a letter, which had been received from the Secretary of the N.V.M.A. on April 25th, on the subject of collaboration between the profession and animal welfare societies, enclosing a copy of the scheme for co-operation with the R.S.P.C.A. and the S.S.P.C.A., the text of which received publication in the *Veterinary Record* of April 29th (**51**, 17, 546-547). The letter pointed out that the scheme had yet to be considered by the councils of those bodies, and expressed the hope that any new arrangements for collaboration between the profession and the relevant society in the area covered by the Division

would be developed in the way suggested in the scheme.

The letter continued: "You will note that in this scheme of co-operation with the R.S.P.C.A. and the S.S.P.C.A., the initial diagnosis and treatment is to be carried out by members of the profession. The Association hopes that the arrangement recently made between the Royal College of Veterinary Surgeons and the People's Dispensary for Sick Animals of the Poor may as far as possible develop along somewhat similar lines.

"At the same meeting on April 4th the Council passed the following resolution with reference to the P.D.S.A.P.:—

> 'That an endeavour be made to form a Joint Committee, consisting of representatives of the Royal College of Veterinary Surgeons and of the National Veterinary Medical Association to evolve a scheme whereby an agreement may be made with the People's Dispensary for Sick Animals that will be acceptable to the profession.'

"This resolution had been referred to the Royal College, but some time must elapse before a satisfactory collective arrangement can be arrived at, and it is suggested, therefore, that individual members should refrain from entering into binding agreements with the P.D.S.A.P. for the time being."

The President now called upon Mr. Cyril King to "open" the discussion on the rapprochement between the R.C.V.S. and the P.D.S.A.P., and after a lengthy discussion, Mr. Holmes moved: "That we hold the next meeting of the Central Veterinary Society to discuss further this question of the rapprochement between the R.C.V.S. and the P.D.S.A., and that if at the conclusion of that meeting we feel it desirable to meet Mr. Bridges Webb, we hold a special meeting later for that purpose."

Mr. Hodgman seconded and the motion was carried unanimously.

"*Some Recent Advances in the Physiology of Cardiac Function.*"—An address on this subject, of great interest, and extensively illustrated by lantern slides, was now given by Professor J. Yule Bogue, of the Royal Veterinary College, shortage of time unfortunately curtailing the discussion, which was informatively opened by Dr. H. Rosenberg, also of the Royal Veterinary College. [Dr. Bogue's address, and a report of the discussion, are reproduced at the commencement of this issue.—*Editor.*]

The President, from the Chair, thanked Dr. Bogue for his exceedingly interesting talk and for the slides he had shown, and expressed the hope that on another occasion Dr. Bogue might be persuaded to give them another address, perhaps elaborating that fascinating subject a little further.

The meeting accorded a hearty vote of thanks, also, to the President for his conduct of the proceedings.

H. E. Bywater, *Hon. Secretary.*

In Parliament

Among the questions and answers recorded in the House of Commons on the last day's sitting prior to the Summer Recess were the following:—

Medicine Stamp Duties

Captain Elliston asked the Chancellor of the Exchequer, whether he can now give the House any further indication of his intention with reference to the Medicine Stamp Duties?

Sir J. Simon: Yes, Sir. I have been in consultation with my right hon. Friend the Minister of Health, and we propose jointly to appoint a committee to examine the whole question. I am not yet in a position to announce the precise terms of reference, but the intention is that the committee's inquiry shall cover both the control and the taxation aspects of the question.

. . . . . .

Milk (Pasteurisation)

Sir Percy Hurd asked the Minister of Health whether his attention has been called to the disclosure in the report of the County Medical Officer for Wiltshire that pasteurised milk used under the milk-in-schools scheme and also pasteurised milk sent wholesale to London and elsewhere has been found to be tuberculous; and what is being done in the matter?

Mr. Elliot: My attention has been called to this report by the county council. I understand that investigations were made and certain pasteurising plants in the county were found to be producing milk which was inadequately pasteurised. The county council informed the local authorities concerned, and the latter took the matter up. In forwarding the report to me the county council recommended that the responsibility for the licensing and supervision of pasteurising plants should be transferred from the local authorities with whom it now rests to the county council. This recommendation would involve an amendment of the Milk (Special Designations) Orders which would doubtless arouse controversy, but I will bear it in mind for consideration when other amendments of the Orders are contemplated.

CHEAP MILK: GOVERNMENT MEMORANDUM

The Government has issued a memorandum to local authorities urging them to take advantage as soon as possible of the scheme to provide cheap milk to expectant and nursing mothers and to children under five. It has been "formally" available to local authorities since July 31st.

People eligible to receive cheap milk may obtain a pint a day either free or for not more than 2d., according to circumstances. The milk will be made available to local authorities at 1s. 4d. a gallon. Any persons wishing to receive milk under the scheme will have first to apply to the local authority. When authorised by the local authority they will ask an approved dairyman to deliver at their home the milk to which they are entitled.

Notes and News

The Editor will be glad to receive items of professional interest for inclusion in these columns.

Diary of Events

Aug. 28th.—Meeting of the Editorial Committee, N.V.M.A., at 36, Gordon Square, W.C.1, 4 p.m.

Aug. 29th.—N.V.M.A. Consultative Committee, 36, Gordon Square, W.C.1, 2 p.m.

Aug. 29th.—N.V.M.A. Finance and General Purposes Committee, 36, Gordon Square, W.C.1, 2.45 p.m.

Sept. 20th.—Applications due for Miss Aleen Cust Veterinary Research Scholarship.

Oct. 4th.—R.C.V.S. Committee Meetings.

Oct. 5th.—R.C.V.S. Committee Meetings.

Oct. 6th.—R.C.V.S. Committee Meetings and **Council Meetings.**

Nov. 1st.—All changes of address to be reported to Registrar, R.C.V.S.

Nov. 6th.—Provisional commencing date of Animal Management Examination.

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GREAT YARMOUTH CONGRESS NUMBER

The next (August 26th) issue of the *Veterinary Record* will be an enlarged and illustrated number devoted to the proceedings of this year's Congress of the National Veterinary Medical Association of Great Britain and Ireland, held at Great Yarmouth from July 23rd to 28th, 1939. Applications for additional copies (price 1s., post free) should be made to the Editorial Representative, N.V.M.A., 36, Gordon Square, W.C.1.

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NATIONAL AIR RAID PRECAUTIONS FOR ANIMALS COMMITTEE

The Air Raid Precautions Department of the Home Office announce that a committee representing the animal welfare movement and the veterinary profession has been constituted to advise on measures to be taken for dealing with animals in time of war. At the request of Sir John Anderson, the Lord Privy Seal, Mr. H. E. Dale, late of the Ministry of Agriculture, has accepted the chairmanship of the committee.

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PERSONAL

Colonial Veterinary Service Appointments.—The following first appointments in the Colonial Veterinary Service are notified: Messrs. S. F. Barnett, M.R.C.V.S., W. J. Gray, M.R.C.V.S., and F. G. Waddington, B.V.Sc., M.R.C.V.S., all as Veterinary Officers, Tanganyika Territory.

For reasons connected with his private affairs the Earl of Feversham has resigned from the office of Parliamentary Secretary, Ministry of Agriculture and Fisheries, as from August 4th.

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R.C.V.S. OBITUARY

Isherwood, James Percy, 2, Holly Avenue, Whitley Bay, Northumberland. Graduated N. Edin. December 22nd, 1890. Died July 18th, 1939; aged 72 years.

Klyne, Richard Edmund, Ivelton, Carbery Avenue, Southbourne, Hants. Graduated London, December 17th, 1902. Died August 9th, 1939; aged 65 years.

. . . . .

Mr. J. P. Isherwood, M.R.C.V.S.

Mr. Isherwood, who was a native of Manchester, began practising on his own account in the Blyth district more than 30 years ago and established an extensive connection in the mining districts of South-East Northumberland. He was also veterinary adviser to various public authorities and co-operative societies, and acted as honorary veterinary surgeon to numerous canine societies in the area.

Mr. Isherwood was a Freemason. He went to reside in Whitley Bay about seven years ago. He is survived by a widow.

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ROYAL (DICK) VETERINARY COLLEGE

Further Appeal for the Extension Fund

In issuing a further appeal to the public the Governors of the Royal (Dick) Veterinary College, Edinburgh, point out that the College still requires about £4,000 to complete some urgently needed extensions to the main buildings. Since 1936, when the first public appeal was made to raise £20,000 which, with a Government contribution of £1 for £1 subscribed, was required for an extension scheme costing £40,000, the Loveday Committee on Veterinary Education has recommended for the College an additional expenditure of £56,000.

The Governors express their gratitude to those who have already subscribed, and state that their obligation to provide the best possible training for students from Scotland and the North compels them to seek the £4,000 immediately required to proceed with the original extension scheme, and the additional £56,000 needed for a field station and increased accommodation for the treatment of cases and the practical training of students in the care and management of animals. It is pointed out that provision for modern veterinary education should be regarded as a most important measure of defence in helping to establish livestock production on a sound footing and providing a valuable reserve of food.

Illustrating the importance of veterinary science to the public, the appeal states that during the past century the veterinary profession in this country succeeded in stamping out, and has since kept out many highly contagious plagues fatal to livestock. About £500,000 has been paid in compensation during the last 18 months to keep foot-and-mouth disease out, but the cost has been far less than in other countries where other methods of control have been adopted. For example, in Germany during the same period, foot-and-mouth disease is officially stated to have cost the equivalent of £80,000,000.

Comprehensive teams of trained workers and more and better accommodation and facilities are stated to be essential at veterinary colleges and similar institutions to carry on the continuous basic study which is required of health factors and diseases. The total capital expenditure of £96,000 "is not a large sum compared with what has been spent on rebuilding the London Veterinary College (over £300,000) or on the majority of European colleges, and is a very small premium to pay for the great assistance, direct and indirect, which a properly equipped and staffed veterinary college in Scotland could give to stock-owners."

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ROYAL AGRICULTURAL SOCIETY

At a recently held Council meeting of the Royal Agricultural Society of England, grave concern was expressed at the increasing number of cases of grass sickness which were reported in Scotland and the northern districts recently. It was noted that in England, particularly in the South, cases are not so numerous, but in Scotland as many as 164 animals had been listed as having succumbed to this complaint in a week.

The question of penalties inflicted by magistrates for cases of concealment of foot-and-mouth disease was also raised in a report of the Veterinary Committee. It was stated that in some instances only trivial fines had been imposed, and it was decided to urge the Ministry of Agriculture to ask the Home Office to draw the attention of magistrates throughout the country to the seriousness of such offences and to stress the danger of allowing offenders to escape with only a minimum penalty.

It was announced that the Society's Gold Medal had been awarded to Professor Sir George Stapledon, for his distinguished services to agriculture.

The dates of next year's Royal Show at Lincoln were fixed for July 2nd to 6th.

Correspondence

Letters to the Editor should reach the Office not later than by the first post on Tuesday morning for insertion in following Saturday's issue.

The views expressed in letters addressed to the Editor represent the personal view of the writer only and must not be taken as expressing the opinion or having received the approval of the N.V.M.A.

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TEACHING OF VETERINARY ANATOMY AND PHYSIOLOGY: THE TYPE ANIMAL

To the Editor of the Veterinary Record

Sir,—We have read with some alarm Dr. Wooldridge's suggestion to the Examination Committee of the Royal College of Veterinary Surgeons (*Veterinary Record*. July 29th. 943) that the type animal for the teaching of Anatomy should be the dog, and are surprised that this has not yet evoked comment in the correspondence columns of this journal.

We are in full agreement with the views expressed by Dr. J. T. Edwards in the deputation of the National Veterinary Medical Association to the Royal College on the Loveday Report (*Veterinary Record*. June 17th. 771), namely, that we need to reorient our system of veterinary education to meet the modern needs in so far as the increased importance of the horse is concerned.

We feel with conviction that the type animal for Anatomy and, so far as is possible, Physiology, should be a Ruminant, preferably the cow.

The advantages the dog appears to possess as a type animal for Anatomy may be convenience of size and the availability of specimens to our city-bounded veterinary colleges and its importance, to a number of town practitioners, as a main source of income. The dog, however, is by no means an indispensable animal to man and one wonders what the future of canine practice would be both in and after any prolonged period of national emergency; whereas, at all times ruminants are the animals of prime economic importance. Furthermore, in the light of the development of the State Veterinary Service with its huge (whole- and part-time) personnel and the ever-growing public realisation of the value of the veterinarian in public health matters, the domesticated ruminants assume a position of rapidly increasing importance, both in health and disease, to the veterinary profession.

With the assumption by ruminants of their proper position as models for Anatomy and Physiology these animals should also receive similar elevation in the sphere of clinical medicine and surgery, and the teaching staffs might be augmented by the appointment of specialists in ruminant practice.

It would seem that it may have been for such reasons as these that the Loveday Report was commissioned, and we believe that the adoption of its recommendation as to increasing the strength of the R.C.V.S. Council by appointment of representatives of the Universities will, if suitable representatives are elected, prove of the greatest value.

We are, Sir,
Yours faithfully,
A Fellow,
A Member and
A Student.

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RE-APPOINTMENT OF AN ADVISER IN ANIMAL HEALTH TO THE SECRETARY OF STATE FOR THE COLONIES

To the Editor of the Veterinary Record

Sir,—It must be a great source of gratification to all members to learn, from your issue of August 5th, that the representations of the Association to the Secretary of State have led to a clearer appreciation of veterinary effort and a consequent favourable forecast as to the appointment of an Adviser in Animal Health.

Implementation of that proposal will provide a much needed encouragement to veterinarians in the Colonial Service whilst the profession in general must be strengthened by such an appointment.

It appears fair, however, whilst paying full tribute to the Association, also to note especially that it was the members of the Colonial Advisory Committee who fought consistently hard and unselfishly to clarify the true importance of veterinary achievement to the welfare of the British Colonial Empire.

I am, Sir,
Your obedient servant,
W. F. Poulton.

Safety in Mines Research Board,
Research Station,
Harpur Hill,
Buxton,
Derbyshire,
August 7th, 1939.